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# medicinal plants of india

vol. I

indian council of medical research
new delhi

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# *Medicinal Plants of India*

*Volume I*

Indian Council of Medical Research
New Delhi

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# FOREWORD

It is widely acknowledged that India has a tremendous wealth of medicinal plants. Unfortunately, however, apart from sporadic attempts by a few reputed investigators, systematic efforts to explore and exploit this valuable potential has been lacking. Real progress in this field could only come through intensive inter-disciplinary work involving organic chemists, pharmacologists and clinicians practising the modern and indigenous systems of medicine.

In 1964, the Indian Council of Medical Research tried to give a new orientation to research on Indian medicinal plants by initiating the Composite Drug Research Scheme under which, for the first time, scientists of different disciplines such as Botany (including Pharmacognosy), Chemistry, Pharmacology and Clinical Medicine (including both Ayurvedic and the Modern systems) were brought together on the same platform to study medicinal plants of promise in an integrated and coordinated manner. Nine main research circuits were established in different geographical locations of the country (depending on the expertise available), each circuit consisting of 5 units, *viz.* a Pharmacognosy unit (in which the botanist identified the plant and described the characteristic morphological features), Chemistry unit (wherein the phytochemist analysed the plant and isolated the active principle), Pharmacology unit (in which the pharmacologist studied the pharmacological activity of the active principle isolated from the plant by the chemist, with special reference to the therapeutic claims made), and the Clinical unit (in which the Ayurvedic team treated patients of particular disease with the drug already studied by the botanist, the chemist and the pharmacologist, according to the therapeutic regimen recommended by the traditional Ayurvedic system, while the modern medical team made their own diagnosis and kept a record of the day-to-day progress and the ultimate outcome of the treatment). This was a unique experiment undertaken not only to study the therapeutic efficacy of single drug regimens as practiced by the Ayurvedic physicians from centuries past, but also to establish scientifically the botanical, chemical and pharmacological basis for the use of a particular plant in specific clinical conditions. During the course of 5 years that this unique scheme was in operation under the council, it was found that nearly 18 plants, out of a batch of 58 selected for study, had reached an advanced stage of investigation.

In the past two decades there have been numerous publications and reports on medicinal plants. However, these publications are widely scattered in journals pertaining to different disciplines like botany, chemistry, pharmacology, pharmacy and medicine. The Indian Council of Medical Research decided to compile the literature on all scientific work conducted on medicinal plants by workers in different parts of India and to present highlights of the work in a systematic way so as to give a total picture of the results of studies so far carried out. For this purpose, data



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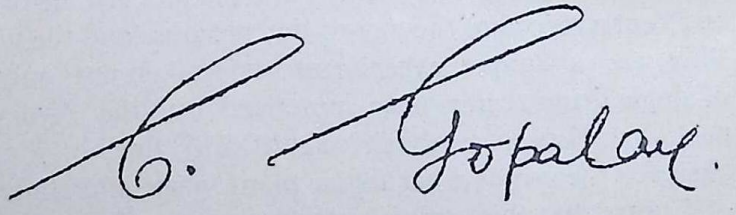
published between 1960-72 have been carefully screened for publication in the form of a monograph to be brought out in 2 volumes.

The present publication is the first volume, and comprises information on nearly 350 species of plants presented in alphabetical order. Apart from the pharmacognostic, phytochemical, pharmacological and clinical data, wherever available, the Ayurvedic description as given in the ancient texts, has been incorporated. A glossary to technical, especially Sanskrit/Ayurvedic terms has been included at the end to help the discerning reader.

An Advisory Committee of eminent scientists reputed for their pioneering work and significant contributions to the field of medicinal plants has assisted the Council in editing the present monograph. All the members of the Committee, the late Prof. T.R. Seshadri, Dr. B.C. Bose, Dr. C. Dwarakanath, Dr. P.N. Mehra and Dr. U.K. Sheth gave their unstinted help and guidance in the preparation of this monograph. Prof. Seshadri and Dr. Dwarakanath, in particular, took special interest in the monograph and scrutinized each chapter critically. It is hoped that those interested and engaged in the study of Indian medicinal plants will find this monograph of interest and utility in their future work.

Dr. G.V. Satyavati, Dr. M.K. Raina and Dr. M. Sharma have carried out, with meticulous care, the job of editing this publication.

The late Prof. T.R. Seshadri was very closely associated with the drafting of this monograph. In fact, even at the time of his sad demise, the manuscript was with him for his final scrutiny. To him, the Indian Council of Medical Research dedicates this first volume of the monograph on Indian medicinal plants, as a humble tribute to the memory of a great phytochemist who devoted a lifetime of enlightened efforts to the study of natural products in our country.



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The Editors would like to express their thanks to the Chairman and all the members of the Advisory Committee for their unstinting help, cooperation and guidance in the preparation of this Monograph. The late Prof. T.R. Seshadri devoted a good deal of his valuable time to scrutinize and edit the entire data on the chemical aspects of the plants. The Ayurvedic description and glossary of Sanskrit/Ayurvedic terms including the note on basic concepts of Ayurveda, as well as the list of vernacular names have been prepared under the direct guidance of Prof. C. Dwarakanath, to whom the Editors are highly beholden.

Shri G.B. Kale was associated with the compilation of material for this publication in the early stages. The constant encouragement and helpful suggestions received from Lt. Col. M.L. Ahuja and Prof. S.L. Bhatia are gratefully acknowledged.

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# INTRODUCTION

The need for a systematic compilation of data on medicinal plants in India has been felt by almost all research workers engaged in the study of medicinal plants. The data available so far are widely scattered in various journals relating to different disciplines such as Botany, Chemistry, Pharmacology, Pharmacy, Medicine *etc.* Although in the past few decades more and more scientists have undertaken research on medicinal plants and brought out results of their work in the form of theses, scientific articles, reviews, proceedings of symposia/seminars/conferences *etc.*, there has been no authentic, comprehensive publication on medicinal plants, subsequent to the monumental reports published by Sir R.N. Chopra and Dr. K.M. Nadkarni nearly two decades ago. In view of this, the Indian Council of Medical Research undertook the compilation of data available from various sources, in order to present them in a systematic and comprehensive manner covering all the aspects worked out by different scientists in various parts of India.

For this purpose, the Council invited scientists engaged in work on medicinal plants to send their published work in the form of reprints, abstracts, proceedings of seminars/symposia/conferences, theses, reviews, reports of various research units *etc.* Several personal communications were also received. In addition to this, a systematic screening of various journals like the Indian Journal of Medical Research, Indian Journal of Pharmacy, Indian Journal of Pharmacology, Indian Journal of Physiology and Pharmacology, Chemical and Biological Abstracts *etc.* published between 1960 and 1972 was also done. The relevant material from all the sources thus compiled was analysed, abstracted, edited and arranged systematically under each plant. The plants have been presented in the alphabetical order of their botanical names. Under each plant are presented the synonyms (if any), vernacular names and habitat, Ayurvedic description (wherever available), medicinal properties and uses, pharmacognostical, phytochemical pharmacological and clinical studies, in that order. Wherever available, illustrations of the plants have been incorporated which, in most cases, are photographs of the herbarium specimens of the plants. A complete list of references has been given for each plant. Common references which occur under almost every plant, such as Chopra *et al.* (1956); Chopra *et al.* (1958); Nadkarni (1954), Wealth of India (1948-56) have not been included in individual references in order to avoid repetition. These have been listed separately at the end. The material incorporated under the heading "Medicinal properties and uses" as well as habitat and vernacular names is based mainly on the reports published by Chopra *et al.* (1956, 1958) and Nadkarni (1954).

An earnest attempt has been made to present the data on each plant in a uniform and systematic manner so as to cover all the aspects. However, for some plants, due to non-availability of detailed reports, it has been possible to give only a brief account



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of work on certain aspects. In case of a few other plants, reports were available only on one or two aspects *viz.* pharmacognostical, chemical, pharmacological or clinical studies. In such cases, whatever report was available on any aspect has been presented.

While describing the pharmacological activities of the medicinal plants, the well known action of commonly known drugs of plant origin which have already been well recognised and described in various text books of Pharmacology or included in various Pharmacopoeias have not been incorporated in this Monograph. Only unusual or new aspects of pharmacological actions not so far investigated and/or reported earlier have been incorporated in case of such plants.

A glossary of Sanskrit/Ayurvedic terms has also been provided to help the readers to understand and interpret the Ayurvedic description given on the various plants. Most of the terms used in the Ayurvedic description are of help in identifying the plants either by means of their organoleptic characteristics and/or their pharmacological properties and therapeutic actions. A brief note on the pharmacodynamic concepts of Ayurveda namely, *rasa*, *guna*, *veerya*, *vipaaka* and *prabhaava* as well as the doctrine of *tridoshas* (*vaata*, *pitta* and *kapha*) has also been presented. A classified list of plants indicating their active principles (wherever available), and the specific pharmacological activity detected has also been given.

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# Medicinal Plants
## (A—G)

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# ABROMA (Sterculiaceae)

*A. AUGUSTA* (Linn.) Willd.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Olatkombal | Mar. | — | Olakatambol |
| Eng. | — | Devil's cotton | Tam. | — | Sivappututti |

**Habitat :** Cultivated as an ornamental tree throughout the hotter parts of India from Uttar Pradesh to Sikkim, Khasia Hills, Bengal and Assam.

**Parts used :** Root, root-bark, stem and leaves.

**Ayurvedic description**

| | | |
|---|---|---|
| Sanskrit | : | *Peevaree,* |
| Synonyms | . | *Pishaachakarpasi, yoshinee* |
| Properties | : | *Rasa* — *Katu, tikta* |
| | | *Guna* — *Laghu, rooksha, teekshna* |
| | | *Veerya* — *Ushna* |
| | | *Vipaaka* — *Katu* |
| Actions/Uses | : | *Yonivyaapadvinaashani, rajodoshaprashamanee.* |

**Medicinal properties and uses :** Root and root-bark are used as an emmenagogue for congestive and nervous dysmenorrhoea; leaves and stem are used in gonorrhoea (Nadkarni, 1954).

**Pharmacognosy :** Samples of *A. augusta* purchased from the local drug market and the authentic ones were compared pharmacognostically.

Macroscopic characters : *Root*—The root is brownish in colour, fracture is fibrous and odour indistinct. Root-bark has a dull brown outer surface which is longitudinally wrinkled alongwith small lenticels. The inner surface is smooth, dark brown and longitudinally striated. Bark is not brittle and can be easily separated.

A young stem is erect, glabrous, green, with prominent nodes and internodes. Commercial samples of the stem bark occur as curved pieces, 6 to 10 cm. in length, 0·5 to 1 cm. in breadth. Outer surface is longitudinally wrinkled. The bark is light, odourless, and has fibrous fracture.

Microscopic characters : *Young root*—In transection, root shows an epidermis composed of cubical cells. The single layered pericycle encloses a triarch stele. Some parenchymatous cells of the phelloderm and phloem disintegrate and form lysigenous type of mucilaginous cavities. Numerous starch grains are present.

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*Mature root* : Periderm consists of 4-6 layers of cork cells, 1-2 layers of phellogen and phelloderm. Mucilaginous cavities formed due to the dissolution of cells are present in between the medullary rays. Starch grains are numerous.

*Root bark* : Periderm has 8-10 layers of cork, 1-2 layers of phellogen and a wide zone of phelloderm. Mucilaginous cavities, starch grains and rosette crystals of calcium oxalate are present. The phloem fibres are thick walled, lignified, pitted and elongated. Medullary rays are funnel shaped.

*Young stem* : A transection shows single layered epidermis with cells forming non-glandular and glandular trichomes. The centre is occupied by a thin walled parenchymatous pith. Mucilaginous cavities are also present, starch grains and rosette crystals of calcium oxalate are present all over the region.

*Young bark* : The cork combium arises in the outermost cortical layers. The pericycle has strands of thick walled lignified fibres forming a discontinuous ring and an intervening parenchyma.

*Mature bark* : Periderm has 6-8 layers of cork cells, 1-2 layers of phellogen and 2-3 layers of phelloderm. The secondary phloem region is wide. The medullary ray cells are brick shaped, thin walled and parenchymatous. The flourescence characters and physical constants have also been studied. Distinguishing features of the root bark and stem bark have been described (Mitra and Prasad, 1971).

**Chemistry** : The roots of the plant were reported to contain an alkaloid abromine, $C_6H_{13}NO_2$, m.p. 283-285°; friedelin and abromasterol A, m.p. 125·5° (Srivastava and Basu, 1956; Ali *et al.*, 1958). Later on, isolation of taraxeryl acetate, taraxerol, β-sitosterol and a low melting neutral compound from the petroleum ether extract of the leaves was reported (Adityachaudhury and Gupta 1969). The roots and leaves were reinvestigated for the characterization of the alkaloid abromine and the sterols isolated previously and to study their pharmaco-dynamic activity.

The quaternary bases isolated as reineckates were found to contain choline, betaine and a base yielding picrate m.p. 223-227°. The identity of abromine was confirmed as betaine. Besides, β-sitosterol and stigmasterol were also isolated from nonsaponifiable fraction of petroleum ether extract of root (Dasgupta and Basu,1970).

The petroleum ether extract of the leaves yielded five compounds with different Rf values. Compound A was a mixture of octacosanol, $C_{28}H_{58}O$ and an alkane $C_{32}H_{66}$. Compound B was a mixture of taraxerol and an aliphatic alcohol. Compound C was pure taraxerol confirmed by its m.p., mixed m.p., IR spectrum etc. Compound D was β-sitosterol acetate and compound E a mixture of long chain fatty diols (Dasgupta and Basu, 1970).

**Pharmacology** : The water soluble fraction of the alcoholic extract of the roots of *A. augusta* had a depressant action on perfused frog heart. The extract was found to have a spasmogenic action on isolated intestines of rat, guineapig, rabbit and dog

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intestine *in situ*, the spasms being partly antagonised by atropine. Spasms produced by the extract on dog's tracheal chain and frog's rectus muscle were blocked by pre-treatment with atropine and d-tubocurarine respectively (Bhattacharya *et al.*, 1969, 1970). Oxytocic action was observed on isolated uteri of guineapig, rat and dog uterus *in situ*. Uterotonic activity was exhibited by the roots when tested on isolated rat uterus, isolated uterine strips of guineapig, rabbit and human and dog uterus *in situ* (Mishra *et al.*, 1966).

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## ABRUS (Leguminosae)

*A. PRECATORIUS* Linn.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Kunch, Kooch | Mal. | — | Gundumani |
| Eng. | — | Jeguirity | Mar. | — | Gunja |
| Guj. | — | Gumchi, Chanothi | Punj. | — | Mulati |
| Hind. | — | Rati, Gunmchi | Tam. | — | Kundumani |
| Kan. | — | Gueugunji | Tel. | — | Guruginia |
| Kash. | — | Shangir | | | |

**Habitat :** Throughout the plains of India, from Himalayas down to Southern India and Ceylon.

**Parts used :** Roots, seeds and leaves.

**Ayurvedic description**

Sanskrit : *Gunja*

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Synonyms : *Gunjavalli, chinchapatri, raktika, kakanautika, bhilla, angaaravalli*

Properties : *Rasa* — *Tikta, kashaaya*
*Guna* — *Rooksha*
*Veerya* — *Ushna*
*Vipaaka* — *Katu/Madhura*

Actions/Uses : Seeds : *Kushtaghna, vranaropana, vedanasthapana, keshya*
Leaves : *Shothaghna, vranaropana*

**Medicinal properties and uses :** Seeds are purgative, emetic, tonic, antiphlogistic and aphrodisiac. Roots are emetic, leaves are used in painful swellings (Nadkarni, 1954; Chopra *et al.*, 1956).

**Chemistry :** Haemagglutinating principle of *A. precatorius* was found to be heat-labile protein located in the cotyledons. Fractionation of the seed extract on DEAE-cellulose column resulted in isolation of the haemagglutinating principle. Fractionation of the seed proteins by paper electrophoresis indicated that the protein component responsible for haemagglutinating activity has the same mobility as β-globulin under identical experimental conditions (Mishra *et al.*, 1968).

Two new alkaloids, the methyl ester of N, N-dimethyl tryptophan metho-cation and picatorine were isolated from the seeds of *A. precatorius*. In addition, abrine, hypaphorine, and two previously uncharacterised bases, now identified as choline and trigonelline were isolated from the seeds. Other parts such as the leaves, stem and roots also furnished the above bases in varying proportions. A special feature is the occurrence of trigonelline as the gallic acid ester (Ghosal and Dutta, 1971).

**Pharmacology :** The preliminary pharmacological investigations of the water-soluble portion of the alcoholic extract of the seed kernels showed parasympathomimetic effect on the smooth muscles of ileum of rabbits, guinea-pig and albino rat, uteri of albino rat and guinea-pig and tracheal chain of dog, skeletal muscle of frog, blood pressure of dog and on perfused frog's heart. The extract was well tolerated up to a dose of 1·5 g./kg. orally (Agarwal *et al.*, 1971).

The antifertility activity of the steroidal fraction (oil) obtained from the seeds was studied on albino rats and mice (Desai and Rupawala, 1967). The oil produced sterility in animals when fed for 20 consecutive days before mating. The antioestrogenic activity of the alcoholic extract of the roots have been studied on female mice and all the three doses *i.e.* 10,100 and 300 mg./kg. were found to be highly effective, (Agarwal *et al.*, 1969). The petroleum ether and alcoholic extracts of the root prevented nidation up to 100 per cent in albino rats on oral administration from 1-5 days post-coitum (Agarwal *et al.*, 1970). The abortifacient activity of the water extract of seeds was observed in mice (Desai and Sirsi, 1964). Subcutaneously, $LD_{100}$ was found to be 2 mg./kg. Orally 25 mg./kg. caused death in 40 per cent of the animals.

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The seeds of the plant showed oxytocic activity *in vitro* in guineapigs. The responses were however, inconsistent and there was some evidence of toxicity to the muscular tissue. The activity was found in globulins isolated from the seeds (Saha, 1961).

The alcoholic ~~extr~~act of the roots caused a transient fall in blood pressure of anaesthetized rats and dogs. The extract also showed a negative chronotropic and inotropic effect on isolated heart of rat. The extract antagonised the stimulant action of histamine on isolated guineapig's ileum (Agarwal and Arora, 1972).

The alcoholic extract of seeds inhibited the growth of pyogenic organisms, *Staphylococcus aureus*, enteric micro-organisms and pathogenic fungi *in vitro* (Desai and Sirsi, 1961; Desai *et al.*, 1970). The water extract exhibited striking effects on the mitotic and meiotic chromosomes in the seeds (Desai *et al.*, 1966; Desai and Sirsi, 1971).

A protein extract isolated from the seeds exhibited antitumour activity against *Yoshida sarcoma* (solid and ascites forms) in rats and fibrosarcoma in mice (Subbareddy and Sirsi, 1968, 1969). The cytotoxic effect of the extract on tumour cells was revealed by the vacuolation and disruption of cytoplasm accompanied by karyolysis and chromosomal abnormalities in ascites tumour cells *in vivo* and also confirmed by *in vitro* studies. Out of the various fractions of purified proteins of the seeds studied for their haemagglutinating properties, toxicity to rats and anti-tumour activity against *Yoshida ascites* sarcoma in rats, only fraction $A_5B$ possessed anti-tumour activity (Lalithakumari *et al.*, 1971).

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## ACACIA (Mimosaceae)

*A. ARABICA* Willd.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Babla | Kon. | — | Shameeruku |
| Eng. | — | Indian gum arabic tree, Babul tree | Mal. | — | Karuvelum |
| | | | Mar. | — | Babhula |
| Guj. | — | Kaloabaval | Punj. and Kash. | — | Sak |
| Hind. | — | Kikar | Tam. | — | Karuvael |
| Kan. | — | Karijali | Tel. | — | Nallatumma |

**Habitat :** Common all over India in dry and sandy localities, plentiful in western Peninsula, the Deccan and Coramandal coast.

**Parts used :** Bark, gum, leaves, seeds, and pods.

**Ayurvedic description**

Sanskrit : *Babboola.*

Synonyms : *Abha, barbura, kinkerata, yugmakanta, dridaaruha, sookshmapatra, peetapushpa, kashaaya, maalaphala.*

Properties :

| | | |
|---|---|---|
| *Rasa* | — | *Kashaaya* |
| *Guna* | — | *Guru, rooksha* |
| *Veerya* | — | *Sheeta* |
| *Vipaaka* | — | *Katu* |

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Actions/Uses : General : *Graahi, atisthambha, kaphakaasahara, aamaateesaraghna, raktaateesara ghna, daahashamani, krimighna, kushtaghna, raktapittahara.*

Gum : *Graahi, raktaateesaraghna, mehaghna, pradaraghna, bhagnasandhanaakara, shonitaasrativarana.*

Flower : *Netrarogaghna, pramehaghna.*

Fruit : *Stambhana, lekhana.*

**Medicinal properties and uses :** Bark is astringent, demulcent and aphrodisiac. Pods are expectorant. Extract of gum is styptic, tonic and astringent.

*A. FARNESIANA* Willd.

Ben. — Guyabadula
Eng. — Cassia flower
Guj. — Jabbaval
Hind. — Vilayati kikar, Gandbabul
Kan. — Karijali
Kon. — Kusri-jhad
Mal. — Kariveelum
Mar. — Guibadhul
Sans. — Arimaedah
Tam. — Pikkaruvel
Tel. — Kempu cumma.

**Habitat :** Found all over India, with bright yellow flowers.

**Parts used :** Bark, leaves, gum, pods and flowers.

**Medicinal properties and uses :** Bark is astringent, demulcent, and alterative (Nadkarni, 1954).

*A. PENNATA* (Linn.) Willd.

Hind. — Bisual

**Parts used :** Leaves.

**Medicinal properties and uses :** Leaves are used in indigestion, bleeding gum and as an antidote for snake-bite (Nadkarni, 1954).

**Chemistry :** Lupeol and α-spinasterol have been isolated from the neutral fraction of the benzene extract of the bark of *A. pennata.* Physical properties suggested the identity of acaciol with α-spinasterol (Sengupta and Chakravarty, 1966).

**Pharmacology** : Aqueous solution of the dried alcoholic extract of *A. farnesiana* in a dose of 20-40 mg./kg. caused transient decrease followed by increase in the rate and force of contraction in isolated perfused frog's heart, whereas in rabbit's heart the same dose of the extract caused initial increase followed by decrease in the rate and force

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of contraction. A dose of 40-80 mg./kg. body wt. produced transient increase in auricular and ventricular contraction on dog's heart *in situ*. A transient fall followed by slight rise in blood pressure was observed in anaesthetized dogs. The extract also caused an increase in the rate and volume of dog's respiration. It had a relaxant effect on isolated rat's and rabbit's ileum. An inhibition of normal rhythmic movements was observed in isolated uterine strip of rat with the extract in a concentration of $1 \times 10^{-3}$ and it antagonised the spasmogenic effects of acetylcholine and barium chloride on rat's uterus (Trivedi and Saxena, 1972).

The saline extract of the pollens of *A. arabica* stimulated the ileum of guineapig and this effect could be blocked by mepyramine and atropine. The petroleum ether extract of the pollens stimulated the rat uterus and the heart of Pila. This effect was blocked by 2—bromo LSD. The effects of acid-treated acetone extract of the pollens was blocked by mepyramine. These studies revealed the presence of acetylcholine, histamine and 5-hydroxytryptamine in the pollens (Rai *et al.*, 1970).

The alcoholic extract of the stem bark of *A. arabica* was found to have antiprotozoal activity against *Entamoeba histolytica*. The extract also showed CNS depressant activity as evidenced by amphetamine hyperactivity test (Bhakuni *et al.*, 1969).

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## ACALYPHA (Euphorbiaceae)

*A.INDICA* (Syn. *A. spicata, A. ciliata*)

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Muktajhuri | Kon. | — | Kunkmiphal |
| Eng. | — | Indian Acalypha | Mal. | — | Kuppamani |
| Guj. | — | Vanchi Kanto | Mar. | — | Khokli |
| Hind. | — | Kuppu | Tam. | — | Kuppivaeni |
| Kan. | — | Kuppigida | Tel. | — | Kuppichettu |

**Habitat :** Common annual shrub grown throughout the plains of India as an ornamental plant.

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**Parts used :** Leaves, root, stalks, young shoots and flowers.

**Medicinal properties and uses :** The whole plant is anthelmintic, expectorant, emetic, anodyne and hypnotic (Nadkarni, 1954). Roots are cathartic; leaves are laxative and used in scabies and snake-bite (Chopra *et al.*, 1956).

**Chemistry* :** Benzene extract of the whole plant left a gummy residue which was dissolved in ether and extracted with 3 per cent NaOH solution. Ether layer was washed with water and dried; the resultant drak green gummy residue was chromatographed and eluted with petroleum ether and benzene (1 : 1). This yielded a fraction which on crystallisation gave a solid with m.p. 85-86°. Further elution with benzene and ether (2 : 1) yielded a second fraction which on further purification gave a solid m.p. 134-136°. This solid was acetylated with acetic anhydride and pyridine. The acetate m.p. 136-137°, crystallised out and on recrystallisation from acetone yielded γ-sitosterol acetate, m.p. 137-139°, molecular formula $C_{31}H_{52}O_2$ (Mukherjee, 1967).

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## ACER (Aceraceae)

*A. RUBRUM*

**Chemistry* :** Besides β-sitosterol and (+) — Catechin, the wood of *A. rubrum* yielded a procyanidin dimer which was identical with the one obtained earlier from *Rhododendron grande* and the bark yielded a trimer which was a new compound. Detailed studies of the chemical properties and spectra of the trimer indicated that it was formed by 4, 8, C — C linkings. The bark also contains small amounts of pyrogallol (Narayanan and Seshadri, 1969).

*A. saccharum* bark and wood contained small amounts of leucocyanidin. *A. saccharinum* bark contained leucocyanidin and gallic acid while the wood contained leucocyanidin only (Narayanan, 1971).

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*No reports available on other aspects.

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# ACHYRANTHES (Amaranthaceae)

*A. ASPERA* Linn.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Apang | Mal. | — | Kadaladi |
| Eng. | — | Rough chaff tree | Mar. | — | Aghada |
| Guj. | — | Safed Aghedo | Punj. | — | Kutri |
| Hind. | — | Latjira, Apamarg | Tam. | — | Nayuruvi |
| Kan. and Kon. | — | Uttaranee | Tel. | — | Uttaraene |

**Habitat :** Small herb found all over India.

**Parts used :** Herb, leaves, seeds and roots.

**Ayurvedic description**

Sanskrit : *Apaamarga*
Synonyms : *Shikhari, adhahshalya, mayooraka, pratyakpusha*
Properties : *Rasa* — *Katu, tikta*
*Guna* — *Laghu, rooksha, teekshana*
*Veerya* — *Ushna*
*Vipaaka* — *Katu*
Actions/Uses : *Krimighna, deepana, paachana, raktavardhaka, sphotahara.*

**Medicinal properties and uses :** Astringent, diuretic, alterative, antiperiodic and purgative (Nadkarni, 1954). The seeds, leaves and twigs of the plant are used in the treatment of renal dropsy and bronchial affections. It is also used in the treatment of leprosy.

**Pharmacognosy :** The pharmacognostical characteristics of the stem and leaf of *A. aspera* have been studied.

*Stem* : The epidermis is covered by glandular hairs and stomata are of rubiaceous type. Idioblasts with prismatic or granular crystals are present. Pericycle has lignified fibres arranged in discontinuous ring. The vascular tissues have 5-6 rings of xylem with small strands of phloem tissue embedded within them. The central part of the stem is occupied by pith with two medullary bundles, either separate or fused.

*Leaf* : Glandular and covering trichomes, stomata similar to those of stem, and rosettes of calcium oxalate crystals are present. The quantitative constants of the leaf e.g. palisade ratio (7·3), stomatal index (upper surface 6·5, lower surface 12·4) and vein-islet number (9) have also been determined.

Some of the distinguishing features of the stem and root have been noted. The stem shows 6-10 ridges and collenchyma is present under each ridge. Both stem and

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root show anomalous growth and have 4-6 successive rings of xylem and phloem. The primary diarch structure is visible intact in the mature root (Prasad and Bhattacharya, 1961).

A distinguishing feature of both the root and the stem is the anomalous secondary growth. Numerous cells with clusters of calcium oxalate crystals are dispersed in the parenchymatous ground tissue, being numerous in the vicinity of the fibrous, conjunctive tissue of the secondary rings. The leaf has a normal dorsiventral structure, with numerous cells containing clusters of calcium oxalate in palisade and spongy mesophyll tissue. 'The seed' sold in the market is actually a dry indehiscent fruit enclosed within a husk of two spinescent bracteoles and 5 scarious perianth leaves. One true seed contains a dicotyledonous curved embryo embedded in a hard horny endosperm. Moisture content, ash values, and stomatal index have also been worked out (Mehra and Karnick, 1969).

A closely allied species *A. bidentata* collected from Simla Hills has also been studied. The structure of its root is very similar to that of *A. aspera* in certain respects like diarch nature of primary wood, anomalous secondary growth in the form of successive concentric vascular rings, tangentia lparenchyma and the abundance of calcium oxalate crystals. It is difficult to distinguish between the roots of the two species except that in *A. bidentata* there is better development of the tangential conjunctive parenchymatous rings with a relatively poor thickening of the interfascicular fibrous tissue. In well developed roots the cortex may be 7 layers of cells thick. The stem has a structure similar to that of *A. aspera*. There are two medullary bundles and successive rings of conjunctive parenchyma. The stem is circular, not angular as in *A. aspera*. Crystals are abundant in the pith as well as in the cortex. The leaf is also undistinguishable from *A. aspera* in histological features. Characteristic trichomes like that in *A. aspera* are present and crystals of calcium oxalate occur in the zone between the palisade and spongy tissue (Mehra, 1969).

**Chemistry :** The whole plant of *A. aspera* has been found to contain traces of basic substances one of which was identified as betaine (Basu *et al.*, 1957a, Basu 1957, Kapoor and Singh, 1966, 1967). A water soluble alkaloid—achyranthine has been isolated from the whole plant (Basu *et al.*, 1957b). From the seeds of the plant a saponin containing oleanolic acid, glucose, galactose, rhamnose and xylose was originally reported (Gopalachari and Dhar, 1952, 1958, Khastgir *et al.*, 1959) but a careful revision of this work has led to the isolation of two well defined and pure saponins which have been called Achyranthes saponins A and B. The structure of saponin A was established as α-L-rhamno-pyranosyl (1...4)-β-D-glucopyranosyl (1...4)-β-D-glucoronopyranosyl (1...3) oleanolic acid and that of saponin B as β-D-galactopyranosyl (1...28) ester of saponin A (Hariharan and Rangaswami, 1970).

**Pharmacological and clinical studies :** The aqueous and alcoholic extracts of the roots of *A. aspera* caused a sharp and transient fall in blood pressure without any significant action on the respiration of anaesthetized dogs. In higher doses, there

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was slight respiratory depression. On frog's heart it had negative inotropic and chronotropic effect. It produced spasm of isolated rabbit's ileum and increased the tone and amplitude of contractions in gravid and non-gravid uteri of albino rats, guineapigs and rabbits. Oral administration of the drug in a dose of 0·5 ml. significantly increased the urinary output in rabbits (Gambhir *et al.*, 1965).

The diuretic activity of the "kshaara" (dried water soluble preparation from the ash of the whole plant) of *A. aspera* was found to be due to its high potassium content (Bhide *et al.*, 1958).

The chloroform-soluble basic fraction isolated from the plant raised the blood pressure of anaesthetized dog, caused initial transitory stimulation of respiration and increased amplitude of contractions of isolated guineapig's heart. It also showed spasmolytic action against various spasmogens on intestine and uterine muscles of guineapigs and a slight diuretic action in rats (Kapoor and Singh, 1967). Achyranthine, produced hypotension, depression of the heart, dilatation of the blood vessels and increase in the rate and amplitude of respiration in anaesthetized dogs. It also showed spasmogenic effect on frog's rectus muscle and diuretic as well as purgative action in albino rats (Neogi *et al.*, 1970).

The alcoholic extract of the whole plant showed hypoglycaemic activity in albino rats (Dhar *et al.*, 1968).

The saponin mixture isolated from the seeds showed a significant increase in the force of contraction of the isolated heart of frog, guineapig and rabbit. The saponin increased the tone of the hypodynamic heart and also the force of contraction of the failing papillary muscle. The effect was quicker in onset and shorter in duration than that exerted by digoxin (Gupta *et al.*, 1972a). Further studies on the phosphorylase activity of the heart in comparison to epinephrine in male albino rats suggested that the increased contractility caused by the saponin could be directly related to its phosphorylase activity as in case of epinephrine. The activity of the saponin was comparable to adrenaline (Ram *et al.*, 1970, 1971a, b).

The saponin mixture *per se* increased the diuretic response of alcohol. The saponin was also found to decrease the antidiuretic response of adrenaline in albino rats (Tripathi *et al.*, 1970). Studies were conducted on the effect of saponin on urine output in adult male albino rats and anaesthetized dogs. The urine output was more in saponin-treated animals as compared to controls (Ram and Gupta, 1970). The diuretic effect was comparable to that observed with 3 mg./kg. dose of mersalyl. The optimum dose of saponin was found to be 10 mg./kg. After oral administration of the saponin (5-10 mg./kg.) in rats, a significant increase in urine output was observed which was comparable to that of 10 mg./kg. oral dose of acetazolamide. The diuretic effect was associated with increase in the excretion of sodium and potassium in urine as found with acetazolamide (Gupta *et al.*, 1972*b*).

The alkaloidal fraction of the alcoholic extract of rootbark inhibited the contractile response of isolated rat uterus suspended in oxygenated modified Ringer solution

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at 30° to 0·01 and 0·015 units of oxytocin. This fraction did not inhibit the response to serotonin and acetylcholine in rat uterus and to histamine in guineapig uterus (Gupta and Khanijo, 1970).

Clinically, administration of the decoction of the whole plant to patients of leprosy has been reported to show encouraging results in lepra reaction as well as the quiescent stage of lepromatous leprosy. Thirty-six patients of advanced, infiltrated and nodular types of lepromatous leprosy who had no previous treatment (as revealed by their histories) were selected for this trial. The patients were given (*a*) the decoction of the whole plant in one group (*b*) DDS (Diamino diphenyl sulphone) in another group and (*c*) the decoction of the whole plant along with DDS in the third group. The decoction was administered orally in a dose of 1 oz. twice daily. Clinical examination using the notations suggested by Dharmendra (1960), lesion index (LI) method of Davison (1965) and the bacterial index (BI) method of Dharmendra (1960) were used. Clinical and bacterial assessments were carried out every three months and finally after one year.

During the whole treatment period a statistically significant change was noted in the clinical condition, bacterial status and general health. All the patients, irrespective of their grouping, showed clinical improvement of varying degrees with a definite suggestion that those who received DDS alone could make a better clinical progress compared with those who received the decoction of *Apamarga* alone, whereas the patients on combined therapy showed the best clinical progress in comparison to those patients who received the different drugs separately. The patients who received only the decoction showed no improvement in their bacterial index (BI). In fact, most of them showed a slight deterioration. The patients on DDS alone and those on a combined therapy of the decoction and DDS showed definite improvement in their bacterial index, whereas those who received both the drugs simultaneously showed a greater improvement. An improvement in general health was observed in all the patients receiving the decoction. Those patients who were on DDS alone did not show any imporvement in general health. It was noted that *Apamarga* did not produce any toxic manifestation in any patient (Ojha and Singh, 1968).

It was further noted that the drug *Achyranthes aspera* was also useful in the treatment of reactions in leprosy, particularly in subacute and mild type. When administered in conjunction with the specific anti-leprosy drug DDS, it was found that the chances of reaction became less and the rate of improvement was faster. This was evident in the clinical trial conducted on 12 cases of reaction selected from the Leprosy Clinic of S.S. Hospital, Banaras Hindu University, Varanasi. No toxic manifestations which could be attributed to the drug *A. aspera* were noted during this trial (Ojha *et al.*, 1966).

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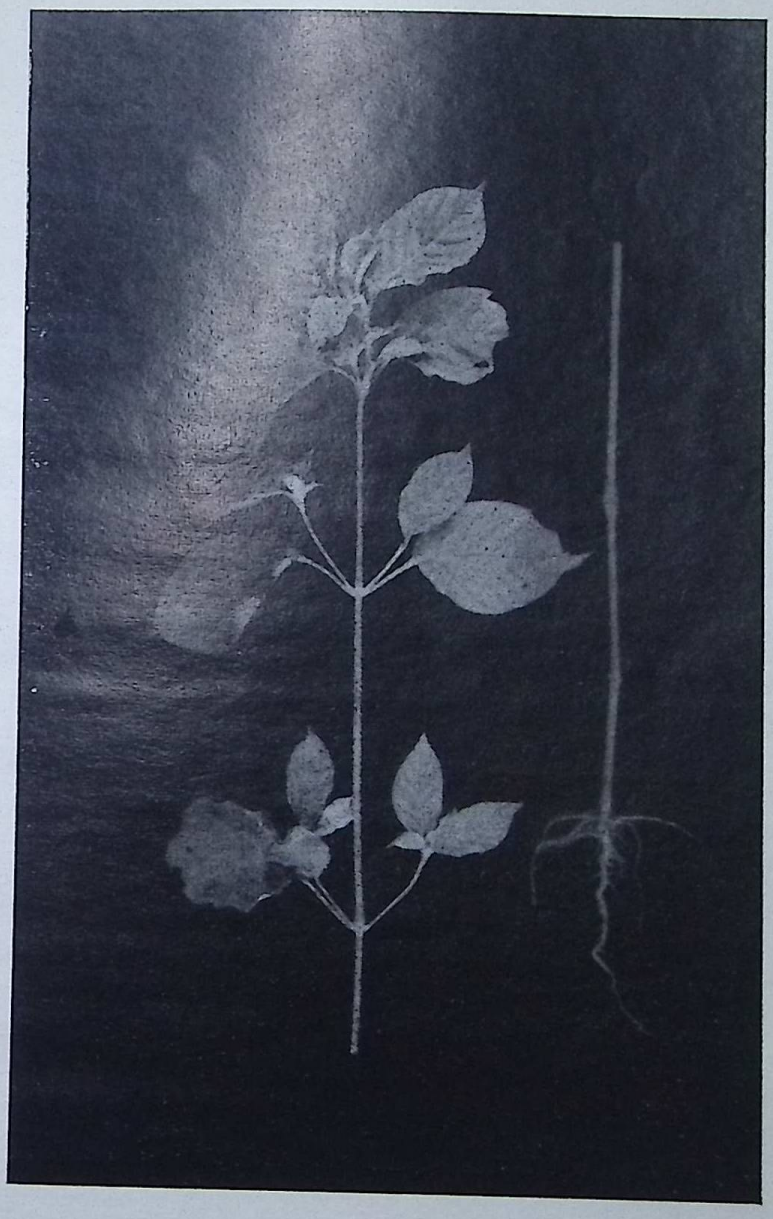

*Achyranthes aspera*

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*Aconitum chasmanthum*

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# ACONITUM (Ranunculaceae)

Aconite, one of the oldest known drugs, is of two different kinds, *viz.* poisonous and non-poisonous, which were identified by Sushruta. Poisonous aconites were called *Vatsnabhi*, which is one of the thirteen bulb poisons. Aconites have been used as medicine externally, internally, alone or in combination with some other drugs. In Ayurveda, they are used usually after mitigation *i.e.* boiling the roots in cow's urine. It is believed that by this process the *Visha* (poison) present in the roots changes to *Amrita* (nector). It was found that the mitigated *A. ferox* acted as cardiac tonic (Mehra and Puri, 1970). In the commercial market, *Vatsnabhi* comprises various species of *Aconitum viz.*, *A. ferox*, *A. falconeri*, *A. spicatum*, *A. laciniatum*, *A. balfouri* and *A. deinorrhizum*. These occur in alpine Himalayas between an altitude of 3,000 and 4,500 m.

*A. FEROX* Wall.

| | | | |
|---|---|---|---|
| Ben. | — Katbish, Mithavish, Bish | Kan. and Kon. | — Vatsanaabhi |
| Eng. | — Indian aconite | Tam. | — Vishanavi, Vishnanuir Vashanari |
| Guj. and Mar. | — Vuchnag. | | |
| Hind. | — Mithazahar, Bish | Tel. | — Vasanubhi |

**Habitat :** Eastern temperate and sub-alpine regions of the Himalayas, eastward of Kumaon, Nepal, Kashmir and Sikkim, Sandhakphu (Darjeeling) at 3,600 m.

**Parts used :** Dried tuberous root.

**Ayurvedic description**

Sanskrit : *Vatsanaabha*

Synonyms : *Amrita, garala, visha*

Properties : *Rasa — Madhura*
*Guna — Rooksha, teekshna, laghu, vyavaayi, vikaashi, yogavaahi*
*Veerya — Ushna*
*Vipaaka — Madhura*

Actions/Uses : *Rasaayana, balya, shuklaprada, brihmana, deepana, graahi, madakari, sheetanut, kantasranaashna, vaataraktaghna, agnimaandyaprashamana, shwaasa-kaasahara, pleehodaraghna, paanduhara, vranaghna, arshoghna, vaatabalasakaghna, gudarogaghna, bhagandaraghna, gulmaghna. grahanirogahara, jwarahara, mootrala, swedajananee, shoolaghna.*

**Medicinal properties and uses :** Roots are diaphoretic, diuretic, antiperiodic, anodyne, antidiabetic, antiphlogistic and antipyretic in very small doses. In large doses it acts as poison, narcotic and as a powerful sedative (Chopra *et al.*, 1956; Nadkarni, 1954.)

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## *A. HETEROPHYLLUM* Wall.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Ataicha | Kan. | — | Ativisha |
| Eng. | — | Indian atees | Mar. | — | Ativisha, Visha |
| Guj. | — | Atavasa | Tam. | — | Atividayam |
| Hind. | — | Atis, Ateicha | Tel. | — | Ativasu |

**Habitat :** It occurs in subalpine and alpine zones of the Himalayas from Indus to Kumaon, at an altitude of 2,500-3,900 m in Central and Western Himalayas.

**Parts used :** Dried tuberous root.

**Ayurvedic Description**

Sanskrit : *Ativisha*

Synonyms : *Shuklakanda, vishwa, bangura, gunavallabha, shishurbheshaja, aruna, shringee, prativisha, mahaushadha, kashmeera, upavisha.*

Properties :
*Rasa* — *Tikta, katu*
*Guna* — *Laghu, rooksha*
*Veerya* — *Ushna*
*Vipaaka* — *Katu*

Actions/Uses : *Paachana, deepana, samgraahee, aamateesaraghna, kaphaateesaraghna, pittaateesaraghna, aamavishaghna, chardiprashamana, krimighna, kapha-pittajwaraghna, kaasaghna, vishahara, shophaghna.*

**Medicinal properties and uses :** Root contains non-toxic amorphous alkaloids and is one of the best bitter tonics for children (Mehra and Puri, 1968).

**Pharmacognosy :** Macro and microscopic characters of the root of *A. heterophyllum* (*Patis*) have been studied. The root can be identified in transverse section from its adulterant *A.. kashmiricum* by the presence of 4-9 xylem bundles near the periphery embedded in secondary phloem tissue. In the root of *A. kashmiricum*, only three xylem bundles are present. Another adulterant *Atees*, has a solitary stele in the centre.

The root is 2-8 cm long and 0·4-1·5 cm thick. Four to nine small cambial rings are present near the periphery. Sieve islets are conspicuous and present in the medullary region. The powder treated with IN NaOH in methanol and mounted in nitro-cellulose when placed under ultra-violet light shows grey fluorescence. These characters distinguish it from *Atees*. It is concluded that the source of *Atees* is not *A. heterophyllum* but some unidentified plant bearing branched tuberous root, while *Patis* of the market is obtained from *A. heterophyllum* (Mehra and Puri, 1968).

Pharmacognostic characters of six species of *Aconitum* called *Vatsnabh* have been described (Mehra and Puri, 1970). These species fall into two classes. The plants in class I *viz. A. falconeri, A. spicatum, A. ferox* and *A. laciniatum*, have stellate cambium

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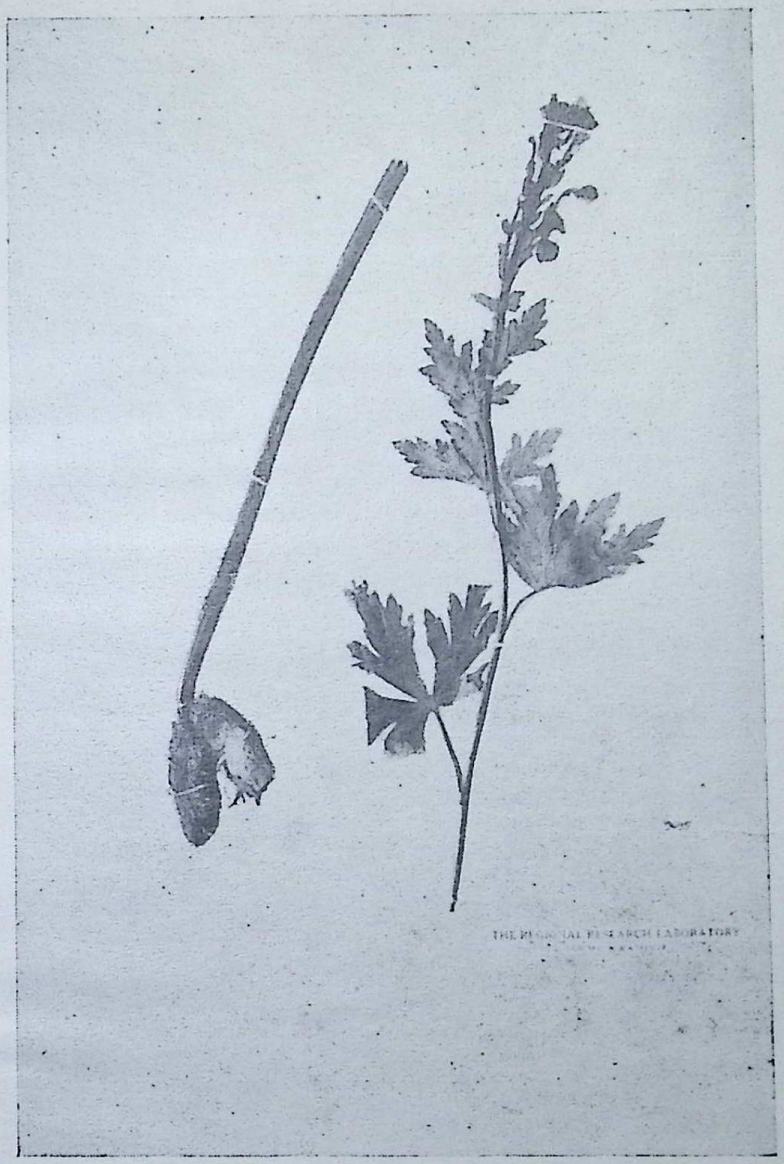

*Aconitum dienorrhizum*

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*Aconitum heterophyllum*

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in the tuberous region of the root and the presence of stone cell is a further distinguishing feature. In *A. falconeri* stone cells are present on both sides of the endodermis, in *A. spicatum* only on its outside, in *A. ferox* only on the inner side and *A. laciniatum* is devoid of stone cells. In class II are placed *A. deinorrhizum* and *A. balfourii* in which in the tuberous region of the root numerous cambial rings are found. These two species can be further distinguished by sporadic occurrence of large stone cells on the outside of endodermis and the disposition of cambial rings in circular fashion in *A. deinorrhizum*. In *A. balfourii* there are relatively small, abundant stone cells on the outside of the endodermis and more or less irregular disposition of cambial rings.

Flourescence characters under U.V. light have been found helpful in identifying the species from one another (Mehra and Puri, 1970).

**Chemistry :** It was found that the alkaloid obtained from *Aconitum* sps. formed a red coloured acetone-soluble complex with ammonium reineckate, the colour intensity of which could provide a direct measure of the quantity of alkaloids present calculated as aconitine. Based on this, a method has been evolved for the estimation of alkaloids in aconite and its tincture (Kannan *et al.*, 1961).

A chromatographic and spectrophotometric study of a few species of *Aconitum* showed that these methods provide a convenient procedure for identification of different species. The method could also be used for the estimation of alkaloids in the crude drug (Khorana and Murty, 1968).

The dry tubers of *A. laeve* were found to have 1 per cent alkaloid which was characterised as lappaconitine by physico-chemical, chromatographic and toxicological studies. The equivalent weight by non-aqueous titration and pKa were determined. Ultra-violet and infra-red studies of the alkaloid have also been reported (Vishwapaul and Handa, 1964).

The new alkaloids tentatively named as 'bishatisine' and 'bishaconitine' have been isolated in pure form from *A. falconeri*. Bishatisine, $C_{23}H_{37}NO_3$ m.p. 295-6° has been tentatively classified as a diterpene alkaloid of atisine group on the basis of elementa-analysis of the base, its salts and derivatives as well as infra-red and ultraviolet absorpd tion spectra. Bishaconitine, $C_{41}H_{59}NO_{13}$ has been classified as a diterpene alkaloil of aconitine group on similar grounds. On alkaline hydrolysis, bishaconitine yielded two aromatic acids, benzoic acid and verateric acid besides an aconine, $C_{25}H_4NO_9$ named as bishaconine (Singh *et al.*, 1966).

**Pharmacology :** Aconitine has been employed to induce writhing similar to agents like phenylquinone, adrenaline, some iodinated compounds and bradykinin. The writhing response induced by aconitine has been used for the measurement of analgesic activity. The characteristic pattern of aconitine-induced writhing response in albino mice has been found to be similar to that induced by bradykinin. Aconitine-induced writhing response was found to be quicker than that induced by bradykinin, to last for a longer period and was consistently observed at 2 mcg. dose level. The response was blocked by analgesic agents (Bhalla *et al.*, 1969).

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The role of catecholamines in centrogenic cardiac arrhythmias induced by aconitine in anaesthetized dogs has been studied. Cardiovascular changes were observed within 5 minutes after giving a dose of 20 mcg. of aconitine into the lateral ventricle. The arrhythmia and hypertension induced by aconitine were centrogenic. The release of endogenous catecholamines from the adrenal glands was found responsible for aconitine-induced arrhythmia, since it could be blocked or prevented by prior administration of reserpine, bilateral adrenalectomy or thoracic splanchnic nerve section. The aconitine-induced arrhythmia was prevented or abolished by α-and β-adrenoceptive receptor blocking agents (Bhargava *et al.*, 1969).

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# ACORUS (Araceae)

*A. CALAMUS* Linn.

| | | | | | |
|---|---|---|---|---|---|
| Eng. | — | Sweetflag | Kon. | — | Ekhanda |
| Guj. | — | Godavaj | Mal. | — | Vayambhu |
| Hind. and Bon. | — | Bach, Gora-back | Mar. | — | Vekhand |
| Kan. | — | Baje | Tam. | — | Vasambu |
| | | | Tel. | — | Vasa |

**Habitat :** A semi-aquatic perennial plant, cultivated in damp marshy places in India and Burma. Exceedingly common in Manipur and Naga Hills, and on the edges of akes and stre ams.

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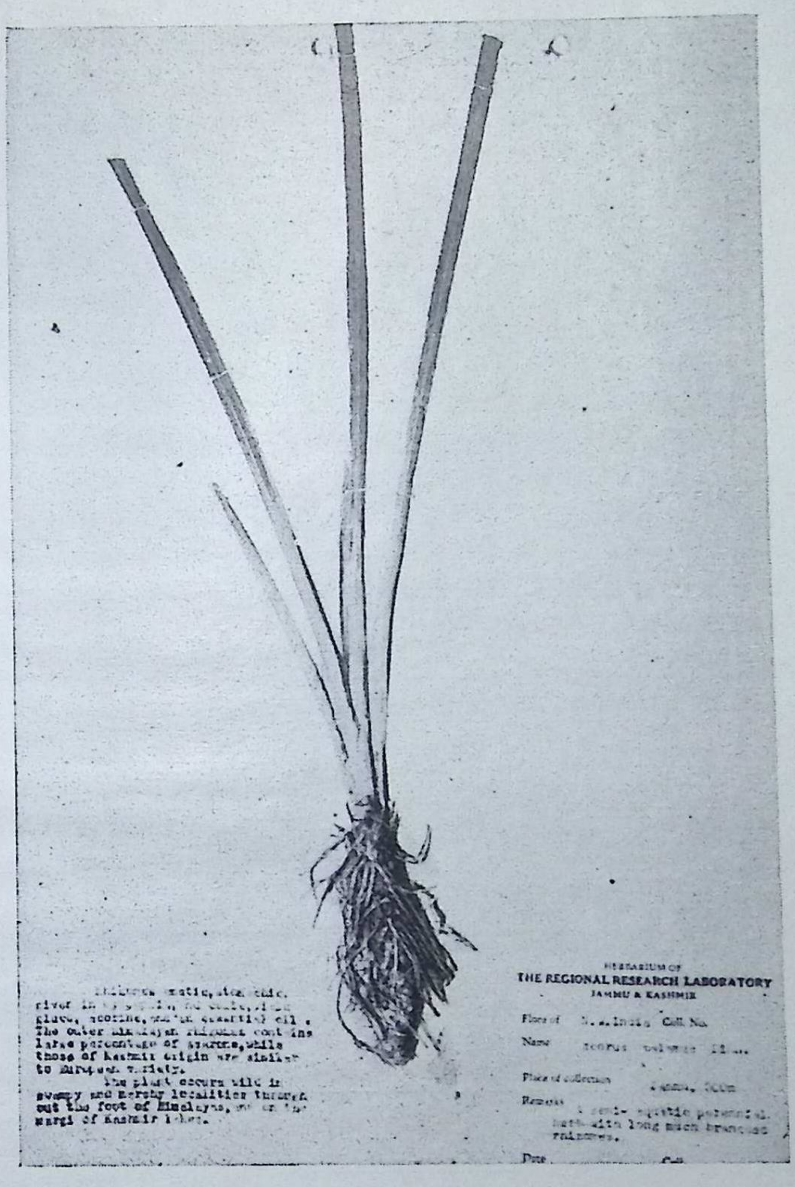


*Acorus calamus*

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*Agave americana*

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**Parts used :** Dried rhizome.

**Ayurvedic Description**

Sanskrit : *Vacha*

Synonyms : *Ugragandha, shadgrantha, golomee, shataparvika, kshudrapatra, maangalya*

Properties : *Rasa* — *Katu, tikta*
*Guna* — *Laghu, teekshna, sara*
*Veerya* — *Ushna*
*Vipaaka* — *Katu*

Actions/Uses : *Kanthya, medhya, krimihara, vibandhaghna, aadhmaanaghna, shoolaghna, vamanakara, vanhikara, shakrit shodhana, mootrashodhani, apasmaraghna, kaphonmaadaghna, bhootaghna, krimighna, anilahara, medhobala buddhivivardhani* (in children).

**Medicinal properties and uses :** Roots and rhizomes are stimulant, emetic, nauseant, stomachic, aromatic, expectorant, carminative, antispasmodic, and nervine sedative. In large doses of 30 to 40 grains, produces a violent and persistent emesis. In the form of infusion, acts as a tonic, stomachic, carminative and also as antiperiodic. The rhizome shows expectorant action due to the presence of essential oil (Nadkarni, 1954).

**Chemistry :** Fractionation of the active principle from volatile oil by gas phase chromatography revealed the presence of two components isolated in pure state *i.e.* α-asarone and β-asarone, which were trans- and cis-isomers, respectively of 2, 4, 5-trimethoxy-1-propenyl benzene (Dandiya, 1970).

**Pharmacology :** The essential oil and the crude alcoholic and aqueous extracts obtained from the roots showed depressant action in dogs. All these inhibited the rhythm of frog and dog heart and relaxed the tone of isolated intestine of guineapigs and rabbits, and isolated uterus of rats. The essential oil was found to be most active as compared to alcoholic and aqueous extracts (Bose *et al.*, 1960).

Asarone and the essential oil had a relaxant effect as well as antispasmodic action against various spasmogens on the ileum of rabbit, guineapig and albino rat, rat's uterus, bronchial muscles of guineapig, tracheal chain of dog and blood vascular muscles of rats. The smooth muscle activity of asarone and essential oil was found similar to that of papaverine. The activity of asarone was greater than that of the essential oil (Das *et al.*, 1962).

α-asarone, an active component of the essential oil and β-asarone prolonged hypnosis caused by pentobarbital, hexabarbital and ethanol in mice. β-asarone facilitated the electroshock seizures while asarone had a slight protective influence. α-asarone in toxic doses caused ataxia, hypnosis, and loss of righting reflex in rats while

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β-asarone failed to induce any of these responses. Asarone, in small doses, potentiated the effect of reserpine and chlorpromazine while β-asarone did not exhibit this effect (Dandiya and Sharma, 1962; Menon and Dandiya, 1963).

The mechanism of tranquillizing action of asarone has also been studied. Asarone was not found to cause any change in the noradrenaline content of whole brain of rats. Unlike tetrabenazine, pretreatment with asarone failed to block the effect of reserpine on the spontaneous motor activity and ptosis of mice, as well as the conditioned avoidance response of trained rats. These findings showed that, though in its chemical structure asarone resembles a part of the reserpine molecule, its mechanism of action is quite different. In animals in which brain noradrenaline had been lowered by pretreatment with α-methyl-L-tyrosine, the effect of asarone *viz.* hypothermia, potentiation of barbiturate hypnosis and specific blockade of conditioned avoidance response, were found to be markedly enhanced. It was found that the sedative effect of asarone was dependent on the depression of the ergotropic division of the hypothalamus (Menon and Dandiya, 1967).

The protective action of the essential oil against electroshock seizures in rats was found to compare favourably with diphenyl hydantoin (Madan *et al.*, 1960). Pretreatment of mice with lysergic acid diethylamide (LSD) partly prevented the hypnotic potentiation of the oil (Dandiya, 1960).

Neuropharmacological actions of the oil revealed its sedative—tranquillizing action in rats, mice, cats, dogs and forced motor activities in mice. In high doses, the oil inhibited monoamine oxidase (Dhalla and Bhattacharya, 1968). Asarone also reduced spontaneous motor activity and caused reduction in anxiety without dulling the perception in rats. It produced prolonged calming effect in monkeys. Asarone failed to cause release of 5-HT from the brain. It also prevented the depletion of adrenal ascorbic acid in rats subjected to cold stress (Dandiya and Menon, 1964**a**, **b**). The effect of asarone has been studied on experimentally induced conflict neurosis in rats. A dose of 3 mg./kg. body weight administered intraperitoneally increased the number of shocks accepted by the animals (Chak and Sharma, 1965). Asarone antagonised the hyper-activity and hallucinogenic effect of mescaline in rats and offered protection to aggregated mice treated with dextroamphetamine (Dandiya and Menon, 1965).

Acorus oil in 50 mg. and 100 mg./kg. dose antagonised the dextroamphetamine induced agitational symptoms. At the same dose, it inhibited the conditioned avoidance response in rats (Bhattacharya, 1968). Cardiac depressant activity was observed both with asarone and β-asarone. Both showed moderate degree of hypotensive action in anaesthetized dogs (Sharma and Dandiya, 1962).

Studies on the *in vitro* effect of acorus oil on the respiration of rat brain revealed that it inhibited the oxygen uptake of brain tissue to varying degrees ; $ED_{50}$ was 1 : 1, 980. The rate of oxygen uptake at different intervals by 100 mg. of the rat brain homogenate in the presence of glucose, sodium glutamate and sodium succinate was 43·1,34.1 and 6·7 respectively. LSD-25 reduced the inhibitory action of acorus oil while 5-HT potentiated it (Dhalla *et al.*, 1961).

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The volatile oil of the roots of *A. calamus* inhibited the growth of *M. tuberculosis* in a concentration of 10 mcg./ml. The oil also inhibited the growth of gram-negative organisms in a concentration of 0·4-0·6 mg./ml. The $LD_{50}$ for guineapigs was found to be 0·6275 ml./100 g. body weight (Chopra *et al.*, 1957).

The insecticidal properties of ether, petroleum ether and alcoholic extracts of the roots of *A. calamus* were studied against the housefly (*Musca nebulo*) and *Bombax mori* larvae and eggs. All the three extracts were toxic to *M. nebulo* adults. Ether extract was found to be 17 times less toxic than DDT. The ether extract was effective as a stomach poison against *B. mori* larvae and 63 times less toxic than DDT. The ether extract was also ovicidal and had no residual toxicity (Mukherjea and Govind, 1960).

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## ACRONYCHIA (Rutaceae)

*A. LAURIFOLIA* Blume

Mal. and Tam. — Muttanari

**Habitat :** Dehradun, Konkan, N. Kanara, Western Ghats of Madras State in hill forests up to 2,000 m, South Deccan Slopes, N. circars, Orissa, Sikkim, 1000-1300 m, Khasia hills up to 1,300 m. in Assam.

**Parts used :** Bark.

**Medicinal properties and uses :** In treatment of ulcers and sores (Chopra *et al.*, 1956; Nadkarni 1954).

**Chemistry :** Acrovestone has been isolated from *A. laurifolia.* Its NMR and mass spectra support the structure assigned earlier. Treatment of acrovestone with aluminium chloride in benzene gave four products which have been identified (Govindachari *et al.*, 1969).

From the root bark of *A. laurifolia,* a minor phenolic constituent, 6-demethyl acronylin, m.p. 154°, $C_{13}H_{16}O_4$, has been isolated along with acrovestone and acronylin (Banerji *et al.*, 1973).

**Pharmacology :** A water soluble alkaloid isolated from the leaves of the plant showed biphasic response on blood pressure. The alkaloid relaxed both intact and isolated intestines. It also showed a depressant action on the central nervous system (Chaurashi *et al.*, 1972).

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## ADINA (Rubiaceae)

*A. CORDIFOLIA* Benth. and Hook.

Ben. — Keli-kadam  Tam. — Manja Kadambe
Hind. — Hardu

**Habitat :** From Himalayas to central and southern India specially common in eastern Ghats, Mysore and parts of Konkan.

**Parts used :** Bark.

**Ayurvedic description**

Sanskrit : *Dharaakadaamba*
Synonyms : *Haridra, haridraka, peetadaaru, kadambaka, haridruma*
Properties : *Rasa* — *Tikta*
*Guna* — *Laghu*
*Veerya* — *Sheeta*
*Vipaaka* — *Katu*
Actions/Uses : *Kaphapittashamana, kushtagna, varnya, vranashodhana, krimighna, jwaraghna, balya,*

**Medicinal properties and uses :** Used as an antiseptic and antifertility agent, and as a febrifuge (Chopra *et al.*, 1956; Nadkarni, 1954).

**Pharmacology* :** In order to study the antifertility effect of the plant, a suspension of the ethanolic extract of the leaves in 10 per cent w/v solution of gum acacia in water was administered orally to female rats daily for five days after mating. It was observed that the extract had no antifertility effect in the rat as observed on the 10th day of pregnancy. Control experiments were carried out with gum acacia in water, noracyclin and alcoholic extract of *Butea frondosa* seeds under the same conditions (Sabir and Razdan, 1970).

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*No report available on other aspects.

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# AEGLE (Rutaceae)

*A. MARMELOS* Corr.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Bela | Kan. | — | Bilvapatre. |
| Eng. | — | Bael fruit | Mal. | — | Baela Koovalam, vilvam |
| Guj. | — | Bilivaphal | Mar | — | Baela |
| Hind. | — | Bel | Tam. | — | Vilvam |
| | | | Tel. | — | Bilvamu |

**Habitat :** Found all over India in sub-Himalayan forests, Bengal, Central and South India and also in Burma.

**Parts used :** Fruits (both ripe and unripe), root-bark, leaves, rind of the ripe fruit and flowers.

**Ayurvedic description**

Sanskrit : *Bilwa*

Synonyms : *Shriphala, maloora, shandilya, shailoosha*

Properties : *Rasa* — *Kashaaya, tikta*
*Guna* — *Laghu, rooksha*
*Veerya* — *Ushna*
*Vipaaka* — *Katu*

Actions/Uses : *Shothahara, arshoghna, vedanasthapana, grahanirogahara, aamadoshaghna, atisaarapravaahikaghna.*

**Medicinal properties and uses :** Ripe fruit is sweet, aromatic, cooling, alterative, and nutritive. When taken fresh, it is useful in habitual constipation, chronic dysentery and dyspepsia. Unripe fruit is astringent, digestive, stomachic and demulcent. Pulp is stimulant, antipyretic and antiscorbutic. Fresh juice is bitter and pungent. Root and stem bark are used as antipyretic (Nadkarni, 1954). Aegelin derived from the plant has been tried in the treatment of bronchial spasm (Dasgupta and Chakravarti, 1958).

**Pharmacognosy :** The characters of the root and stem bark have been described.

Macroscopic characters : The root-bark is 3·5 mm. thick, curved with its surface cream yellow or greyish in colour. The surface is rough, irregular and shallow with ridges along the line of lenticels and ruptured all over. The stem bark is externally grey and internally cream in colour. The outer surface is rough and warty. It is 4-8 mm. thick and is firm in texture, and occurs as flat or channelled pieces. The fracture is tough and gritty in outer region and fibrous in the inner; taste is sweet.

Microscopic characters : The root in transection shows a penta to heptarch stele, cork cambium arising in pericycle. In mature bark the cork is lignified and stratified,

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the phelloderm is composed of a wide zone of parenchyma cells and strands of stone-cells. The medullary group in the inner region are unito tri-seriate, while in outer region they are bi-to penta seriate.

The characters by which the root bark can be differentiated from the stem bark are summarised in Table (Prakash and Prasad, 1969).

| Character | Root bark | Stem bark |
|---|---|---|
| Colour | Cream yellow to yellowish brown, less warty and more numbers of cracks and fissures. | Grey, more warty and less number of cracks and fissures. |
| Thickness | 3-5 mm. | 4-8 mm. |
| Cork | A wide zone showing 4-7 stratifications. | A wide zone showing 5-8 stratifications. |
| Stone-cells | Present in lesser number of groups in the phelloderm and absent from the phloem. | Present in more number of groups in the phelloderm and also present in groups in the phloem. |
| Fibres | Present in groups arranged in concentric rings. | Present in groups arranged in concentric rings. The number of such rings is more than in root bark. |
| *Fluorescence* | | |
| Powder as such | White with violet tinge. | Brownish yellow. |
| Powder mounted in nitro-cellulose | Violet. | Buff. |

**Chemistry :** A sterol—Aegelin, $C_{18}H_{18}O_4$, m.p. 175°, was isolated from the leaves of the plant (Chatterjee and Bose, 1952). It was first described as a steroid by earlier workers, but after re-investigation it was found to be a neutral alkaloid, $C_{18}H_{19}O_3N$ with one methoxyl and one hydroxyl group but no N-methyl or C-methyl groups. With degradative studies the structure of aegelin has been established (Chakravarti and Dasgupta, 1955). The structure was further supported by the synthesis of aegelin, its oxidation and reduction products, *viz.* aegelone, dihydronegelin and dihydroaegelone. Attempts have been made to isolate the real sterol constituent of the leaves (Chakravarti and Dasgupta, 1956a).

The non-volatile, non-saponifiable fraction of the ether extract of the leaves, on chromatography, yielded a sterol having m.p. 144-145° and identified as γ-sitosterol. A modified method for the isolation of aegelin from the leaves of *A. marmelos* has

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also been described. The seasonal variation in the yield of aegelin has also been studied; the yield is negligible during December to February and maximum (0·2 per cent) during June to August (Chakravarti and Dasgupta, 1956**b**, 1958**a**, **b**; Dasgupta and Chakravarti, 1958).

Aegelin, on hydrolysis, gave trans-cinnamic acid. By UV studies of aegelin and comparison with those of trans-cinnamic acid, trans-cinnamide and trans-N-methyl-cinnamide, the trans-configuration of the cinnamoyl grouping in aegelin was confirmed (Chakravarti and Dasgupta, 1958**c**).

Further studies on the leaves resulted in the isolation of several new coumarins and alkaloids. The composition of aegelenine (a minor alkaloid) was $C_{14}H_{12}N_2O_2$ and a tentative structure was given on the basis of results of some of its degradation studies. The alkaloid, crystallised from ethanol as pale yellow solid, m.p. 245° and analysed for the molecular formula $C_{14}N_{10}N_2O_2$. Mass spectral analysis of the alkaloid showed a significant peak at M-35 (Chatterjee *et al.*, 1967**a**).

Marmin, a new coumarin with m.p. 123-124° was isolated from the trunk bark of *A. marmelos*. The molecular formula was found to be $C_{19}H_{26}O_5$. But mass spectrometric and NMR studies showed the correct molecular forumla to be $C_{19}H_{24}O_5$ and its chemical structure has been determined (Chatterjee *et al.*, 1967**b**).

Aegelenine, the minor alkaloid of the leaves of *A. marmelos* has been found to be a phenolic base having an oxazole and a pyridine moiety. From UV, IR, NMR and mass spectra and from degradative experiments, the structure of aegelenine was elucidated and found to be identical with halfardinol, the basic constituent of *Halfordia scleroxyla*, family Rutaceae (Chattrejee and Majumdar, 1971).

**Pharmacology :** The aqueous and alcoholic extracts of the leaves of *A. marmelos* caused an increase in amplitude and force of contractions of frog's heart similar to that shown by digoxin. Both these extracts stimulated the ventricles of dog's heart, as seen from the electrocardiograms (Haravey, 1968).

The alcoholic extracts of the roots and fruits of *A. marmelos* showed hypoglycaemic activity in albino rats. The fruit extract showed antiviral activity against Ranikhet disease virus (Dhar *et al.*, 1968).

Marmelosin, isolated from the plant showed anthelmintic activity against ankylostomiasis, the test organism employed being *Nippostrogylus muris* (Lamba and Bhargava, 1969).

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## AGAPANTHUS (Liliaceae)

*A. UMBELLATUS* L'Herit (Syn. *A. africanus* (Linn.) Hoffm.

**Habitat :** Found in North India.

**Chemistry*** **:** Yuccagenin, agapanthagenin, β-sitosterol and an unidentified sterol with m.p. 190°, were isolated from the rhizome. The rhizomes were extracted with alcohol and the combined extract was evaporated. The residue was treated with 3 per cent hydrochloric acid, precipitated and extracted with benzene. Benzene extract was subsequently washed with 10 per cent sodium hydroxide and water and dried. This was chromatographed over alumina and four crystalline fractions were obtained as given below :

Fraction A : Obtained from benezene eluate and recrystallised from acetone : methanol (2 : 1) gave shining plates, m.p. 140°, molecular formula $C_{29}H_{50}O$, with positive colour reactions for sterols. Its identity was confirmed as β-sitosterol.

*No report available on other aspects.

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Fraction B : The benzene chloroform (1 : 3) eluate when recrystallised from acetone gave shining plates m.p. 190°, molecular formula $C_{29}H_{50}O$.

Fraction C : Obtained from chloroform : methanol (99 : 1) and when recrystallised gave needles m.p. 238°, molecular formula $C_{27}H_{42}O_4$. It agreed with Yuccagenin.

Fraction D : From chloroform: methanol (19 : 1) when recrystallised gave shining plates m.p. 282° and molecular formula $C_{27}H_{44}O_5$. The properties of fraction D and its derivatives were like those of agapanthagenin and its derivatives (Cyriac *et al.*, 1972).

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## AGAVE )Amaryllidaceae)

*A. AMERICANA* Linn.

| | | | | | |
|---|---|---|---|---|---|
| Ben. and Mar. | — | Janglianarash | Mal. | — | Eroppakaita |
| Eng. | — | American Aloe | Sans. | — | Kantala |
| Guj. | — | Jangli-Kanvar | Tam. | — | Anaykattazhey |
| Hind. | — | Barakhawar | Tel. | — | Rakashimatalu |
| Kan | — | Anekattaale | | | |

**Habitat :** Found throughout India.

**Parts used :** Roots, leaves and gum.

**Medicinal properties and uses :** Root is diuretic and anti-syphilitic. Sap is laxative, diuretic, emmenagogue and antiscorbutic (Nadkarni, 1954).

*A. CANTALA* Roxb

Kan. — Kalnaru Mar. — Ghayal

**Habitat:** Common throughout Bombay and Madras.

*A. VERA-CRUZ* Miller

Mar. — Latia ghaial

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**Habitat :** Common throughout Bombay and Madras.

**Chemistry :** Hecogenin was obtained in a greater yield from the residues left after extration of long fibres (sisal fibres) from *A. cantala.* The petroleum ether extract on removal of the solvent yielded the sapogenin residue which, on purification by chromatrography, yielded pure hecogenin m.p. 264-265°, and gave hecogenin acetate m.p. 243-245° and hecogenin benzoate m.p. 260° (Chakravarti *et al.*, 1962).

Hecogenin was also isolated from the leaves of *A. americana* in a yield of 0·065 per cent. Its identity was confirmed by mixed melting point determination (Singh and Pereira, 1964).

Chlorogenin was isolated in a yield of 0·5 per cent from the fresh flowers of *A. americana.* The flavonol glycosides were identified as kaempferol—3—glucoside and kaempferol—3— rutinoside (Subramanian and Nair, 1970).

**Pharmacology :** Polyfructosan obtained from *A. vera-cruz* and inulin at 5 per cent levels, fed to rats for a period of 6 weeks reduced cholesterol levels in plasma very significantly, while in liver there was no reduction of cholesterol level except in inulin fed rats which were given exogenous cholesterol. A slight increase in the faecal excretion of sterols (digitonin precipitate) was observed in rats fed with polyfructosan while with inulin no difference was observed (Subba Rao *et al.*, 1965).

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## AGRIMONIA (Rosaceae)

*A. EUPATORIA* Linn. (Syn. *A. pilosa* Ledeb)

Eng. — Agrimony

**Habitat :** It grows in small clumps and occurs in the temperate Himalayas from Muree and Kashmir to Sikkim (1,000-3,500 m) and in the Khasia and Mishmi Hills (1,500-2,000 m).

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**Parts used :** Root and leaves.

**Medicinal properties and uses :** Leaves are used to make a tonic tea and root is used both as an astringent and tonic (Chopra *et al.*, 1956).

**Pharmacognosy* :** The macro and microscopic characters of the root of the plant have been described. Roots are cylindrical with numerous lateral rootlets. The powdered root is brownish pink to dirty pink in colour. The salient microscopic features are the presence of fragments of polyderm layers with the other dead cells and the alternating layers of suberized endodermoid cells and the intervening biseriate parenchyma cells.

In the powdered root patches of outermost cells of polyderm, abundant simple or compound starch grains, circular or oval in outline and measuring 12-16 μ in diameter. Parenchyma cells from secondary cortex, fragments of lignified xylem elements *viz.*, vessels, tracheids, fibre tracheids, wood fibres, xylem parenchyma, *etc.* with their characteristic pittings and a lot of cell debris are seen (Madan and Kundu, 1961).

**Reference**

Madan, C.L. and Kundu, B.C. 1961. Pharmacognosy of the root of *Agrimonia eupatoria* Linn. **J Sci Indust Res 20C,** 348.

## AILANTHUS (Simarubaceae)

*A. EXCELSA* Roxb.

| | | | | | |
|---|---|---|---|---|---|
| Guj. | — | Ardusi | Mal. | — | Matti pongilyam |
| Hind. and Mar. | — | Maharuk | Tam. | — | Perumarudu |
| Kan. | — | Doddamara | Tel. | — | Peedamanu |

**Habitat :** A large deciduous tree occurring in Bihar, Chota Nagpur, the Central provinces, Gujarat and in the forests of Ganjam, Visakapatnam and Deccan (Wealth of India, 1948).

**Parts used :** Leaves and Bark.

*No reports available on other aspects.

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*Agrimonia eupatoria*

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*Albizzia lebbeck*

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**Ayurvedic description**

Sanskrit : *Aralu*

Synonyms : *Mahaanimba, nimbaakaaradala, vishwak, bhallukah, panktipatrakah, bhangarah, asaaraah, adoosha.*

Properties :

| | | |
|---|---|---|
| *Rasa* | — | *Tikta* |
| *Guna* | — | *Laghu* |
| *Veerya* | — | *Sheeta* |
| *Vipaaka* | — | *Katu* |

Actions/Uses : *Deepani, graahi, krimighna, kushtaghna, vastirogahara, sannipaata jwarahara.*

**Medicinal properties and uses :** Leaves are bitter tonic, carminative and febrifuge. Bark is expectorant and antispasmodic (Nadkarni, 1954).

*A. MALABARICA* DC [Syn. *A. triphysa* (Demnst). Alst.]

| | | | | | |
|---|---|---|---|---|---|
| Kan. | — | Hemmara, Dhoopa | Tam. and Mal. | — | Perumaram |
| Mar. | — | Gugguladhup | Tel. | — | Madipalu |
| Sans. | — | Mahanimba | | | |

**Habitat :** Found in Malabar coast, Travancore and Ceylon.

**Parts used :** Bark, fruit and gum.

**Medicinal properties and uses :** Bark is used in treatment of dyspepsia, chronic bronchitis, asthma, diarrhoea and as a tonic and febrifuge (Nadkarni, 1954).

**Pharmacognosy :** *A. excelsa* has been found to be an adulterant of *Vasaka* leaves. The market samples consisted of broken leaves, midribs, petiolules, and occasionally bits of rachis bearing scars of pinnae. The colour is greyish green, pieces of leaf are soft and velvety in texture, margin is irregularly toothed, pinnae are unequal at the base and petiolule is not grooved. In transection, the leaf is observed as subcentric type with a single row of palisade cells. Cuticle is striated, epidermal cell walls are straight with a tendency for beading. Stomata of anomocytic type are present, wall of covering trichomes is not warty. Glandular trichomes with multicellular head on multicellular stalk are present. Abundant solitary and cluster crystals of calcium oxalate are present along the veins. Cystoliths are absent. Medullary bundles and isolated phloem groups in the medulla are present. A characteristic anamoly in the vascular anatomy of the stalk is seen and palisade ratio has been found to be 6-8-10 (upper epidermis) and stomatal index 5-9-12 (Satakopan and Thomas, 1970).

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**Chemistry :** A crystalline steroid, m.p. 153° with molecular formula $C_{21}H_{30}O_4$ and designated as malanthin was isolated from the bark of *A. malabarica*. A partial structure has been assigned to malanthin on the basis of its ultraviolet and infrared absorption spectra (Rastogi and Dhar, 1957). β-sitosterol and vitexin were isolated from *A. excelsa* (Kapoor *et al.*, 1971).

**Pharmacology :** The aqueous extract of the leaf, stem and bark of *A. excelsa* produced hypotensive effect on dog's blood pressure. Tachycardia was observed after administration of the extract. The drug also relaxed isolated rabbit's intestine (Sharma and Singh, 1960).

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## ALANGIUM (Alangiaceae)

*A. LAMARCKII* Thwaits.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Akar—Kanta | Mal. | — | Ankolam |
| Eng. | — | Sage-leaved alangium | Mar. | — | Ankoli |
| Guj. | — | Onkla | Tam. | — | Alanji |
| Hind. | — | Akola | Tel. | — | Ankolamu |
| Kan. | — | Ankolemara | | | |

**Habitat :** Common in tropical forests of South India and Burma.

**Parts used :** Root, root-bark, seeds and leaves.

**Ayurvedic description**

Sanskrit : *Ankola*

Synonyms : *Deerghakeela, gandhapushpa, taamraphala, guptasneha.*

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Properties : *Rasa* — *Tikta, katu and kashaaya*
*Guna* — *Laghu, snigdha, teekshna, sara*
*Veerya* — *Ushna*
*Vipaaka* — *Katu*

Actions/Uses : General : *Vishaghna, krimighna, sarpamooshikavishahara, rechanee, vranaghna, jantuvishaghna, kanthashoolashodhanee, shophaghna, visarpahara, raktapittaghna.*
Fruits : *Vishtambhi, agnijit.*

**Medicinal properties and uses:** Root bark is purgative, anthelmintic, useful in fever and skin diseases. Leaves are used as poultice in rheumatic pains. Root is laxative and anthelmintic, fruit is cooling, nutritive and tonic (Chopra *et al.* 1956, Nadkarni, 1954).

**Chemistry :** An alkaloid, alangine-A, m.p. 85°, has been isolated from the plant. On zinc dust distillation, pyridine and n-propyl benzene were obtained. On oxidation with nitric acid, oxalic acid and p-anisic acid were formed. On the basis of the above data, the structure of alangine-A was formulated as 3-anisyl-2-piperidyl-n-propanol (Bhakuni, *et al.* 1960). However, on synthesis, DL-3-Anisyl-2-piperidyl-n-propanol has been found to be different from alangine-A and its structure need revision (Kapil *et al.* 1961).

A new crystalline phenolic alkaloid, ankorine has been isolated from the leaves having m.p. 174-176° and molecular formula $C_{19}H_{29}O_4N$. It has two-$OCH_3$ groups, one phenolic-OH group and possibly one furan ring (Dasgupta, 1965).

Choline was also isolated from the aqueous solution of the leaves. The water soluble quaternary base was precipitated with ammonium reineckate. Paper chromatographic study showed that the isolated quaternary base gave a pink spot similar to choline chloride but different from the spot of acetylcholine chloride. The base was crystallised from alcohol. The picrate prepared from the base melted at 242-244° and there was no depression in melting point when mixed with picrate prepared from an authentic sample of choline chloride (Dasgupta, 1966). Some steroids and terpenoids have also been isolated from the leaves (Dasgupta and Sharma, 1966).

Three new alkaloids have been isolated from the leaves. This first, alangimarckine, $C_{29}H_{37}N_3O_3$ m.p. 184-6°, was found to be identical with ankorine. The third alkaloid closely resembled deoxytubulosine. The mass spectrum was identical with that of dihydroprotoemetine (Battersby *et al.* 1966).

After the separation of alkaloidal bases from the root bark of the plant, the alcoholic extract yielded a white deposit and a light brown wax. The white compound m.p. 78°, had the molecular formula $C_{26}H_{57}O$, acetyl derivative m.p. 64-65° was found to be one of the ceryl alcohols. The light brown wax contained non-saponifiable matter 16·8 per cent, myristic acid 6·73 per cent, palmitic acid, 9·36 per cent, oleic acid

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85·8 per cent, linoleic acid 3·7 per cent and resin acids 2·3 per cent. The alcoholic components were myricyl alcohol and sterols among which stigmasterol, sitosterol and β-sitosterol were detected in non-saponifiable matter. (Sharma and Gupta, 1966).

Chemical investigation of the root bark and stem bark showed that both these contained a mixture of alkaloids. From the mixture, only one alkaloid was isolated in a pure crystalline form by chromatography over alumina. The eluate which was crystallised from dilute methanol in colourless needles, m.p. 256-57°, gave characteristic tests of a tetrahydro-β-carboline. The molecular weight, ultraviolet spectra and acetylation tests confirmed the identity of the alkaloid as tuburlosine $C_{31}H_{39}N_3O_4$ which was further confirmed by mixed m.p. determination and infrared spectra (Salgar and Merchant, 1966).

Desmethylpsychotrine and alangicine are two other new alkaloids isolated from *A. lamarckii* (Pakrashi and Eshakali, 1967).

Betulinic acid, betulinaldehyde, betulin, and lupeol showing a remarkable biogenetic sequence, along with hydroxylactone-A of betulinic acid and β-sitosterol have been isolated from the seed kernels of *A. lamarckii*. The hydroxylactone-B of the triterpene acid isolated in the neutral part during chromatographic separation was possibly an artefact. It has, however, been shown to have equatorial hydroxyl function. The preparation of 3-deoxybetulonic acid, m.p. 270-271° was also reported (Pakrashi *et al.*, 1968).

The isolation and characterisation of dihydroprotoemetine, ankorine and alangimarckine from the plant clearly showed the occurrence of a monoterpenoid alkaloidal glycoside named alangiside, as an intermediate in this plant. Further studies showed the presence of a cyclopentanoid monoterpene carboxylic acid which was characterised as loganic acid (Shoeb *et al.*, 1969).

**Pharmacology :** The total alkaloidal fraction of the leaves of the plant was administered orally to albino rats to study its anti-inflammatory effect, using formalin induced arthritis and granuloma pouch techniques; β-methasone was used for comparison. A significant increase in the inflammatory reactionw as observed during the first five days and it reduced foot volume from the eleventh day onwards in formalin-induced arthritis. The drug was, however, toxic and 66·7 per cent of rats died during treatment. A reduction in food intake and faecal output of rats was observed after administration of the drug (Prasad *et al.*, 1966).

The total alkaloidal fraction of the leaves had a non-specific antispasmodic effect in rat's and rabbit's ileum. A biphasic action was observed on isolated rabbit ileum and rat uterus. An increase in rhythmic movements was observed in lower concentrations but in higher concentrations, a decrease in rhythmic movements and relaxation was seen. The drug potentiated acetylcholine-induced spasm. The alkaloids also showed anti-cholinesterase activity on dog's blood. 0·5 mg./kg. to 10 mg./kg. produced a fall in blood pressure of anaesthetized dog. The hypotensive effect of the drug was not affected by pretreatment with 1 mg./kg. of atro-

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pine sulphate. However, pretreatment of the dogs with pentolinium tartrate (1 mg./kg.) reduced the hypotensive action of the alkaloids (Sanyal *et al.*, 1965).

A quarternary base isolated from the water-soluble fraction of the alcoholic extract of leaves produced a fall in carotid blood pressure of anaesthetized dogs. The effect was not altered by pretreatment with eserine, but pretreatment with 1 mg./kg. of atropine blocked the hypotensive effect and at the same time caused a rise in the carotid blood pressure. The drug increased the tone and amplitude of contraction of isolated ileum of rabbit. It produced spasmodic contraction of the rectus abdominis muscle of frog; the effect was not blocked by pretreating the tissue with 50 mcg. tubocurarine chloride (Sanyal *et al.*, 1966).

The root-bark extract of the plant showed anthelmintic effect only against poultry ascarids, but had no effect against bursate worms of sheep and hook worms of dog (Dubey and Gupta, 1968).

The alcoholic extracts of the leaves of *A. salvifolium* showed hypoglycaemic activity in albino rats. It also possessed anti-protozoal activity against *Entamoeba histolytica* (Dhar *et al.*, 1968).

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## ALBIZZIA (Mimosaceae)

*A. LEBBECK* (Linn.) Benth.

| | | | | | |
|---|---|---|---|---|---|
| Hind. | — | Siris | Tam. | — | Vaghay |
| Kan. | — | Bagey | Tel. | — | Dirisana |
| Mar. | — | Motha siris | | | |

**Habitat :** Found throughout India, up to 1,200 m. in the Himalayas. The plant is also cultivated.

**Parts used :** Bark, leaves and seeds.

**Ayurvedic description**

Sanskrit : *Shireesha*

Synonyms : *Mrudupushpa, shukataru, shukapriya, kappeetana*

Properties : *Rasa* — *Madhura, tikta, kashaaya*
*Guna* — *Laghu, rooksha, teekshna*
*Veerya* — *Sheeta*, according to some and slightly *ushna* according to others.

Actions/Uses : *Vishanaashana*, (specially *sarpa* and *mooshika visha*), *vedanasthapana, kaasahara, shwaasahara, shirovirechana, sthambhana.*

**Medicinal properties and uses :** Bark is used as a remedy for bronchitis, leprosy, paralysis, gum inflammation and helminthic infections. Whole plant is used in snake-bite and scorpion-sting. Root-bark in powder form is used to strengthen the gums. Leaves are useful in night blindness (Chopra *et al.*, 1956, Nadkarni, 1954).

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*A. LUCIDA* Benth.

Ben. — Silkoroi

**Habitat :** Deciduous tree, from Nepal eastward to Assam, in tropical forests of Burma. Grows wild along the banks of streams and in moist places. A common garden plant, grown along avenues.

**Parts used :** Seeds and leaves.

*A. PROCERA* (Roxb.) Benth.

Ben. — Kori
Hind. — Safed siris
Mar. — Kinhai
Tam. — Kondavagei
Tel. — Tellachinduga

**Habitat :** Grows in sub-Himalayan tract, from Jumna eastwards; Bengal, Orissa, Madhya Pradesh, Maharashtra and South India. Occasionally planted as ornamental or roadside tree.

**Parts used:** Leaves

**Medicinal properties and uses :** Leaves are used as insecticide, made into poultice and applied to ulcers (Chopra *et al.*, 1956).

**Pharmacognosy :** Macroscopic and microscopic characters of young stem and old bark of *A. lebbeck* have been studied. The bark is dark brown to greenish black and rough, covering being acrid. In young stem the epidermis has a wavy cuticle and unicellular taste trichomes are present. Some cortical cells are lignified. Prismatic crystals of calcium oxalate are present. Rhytidome shows alternate layers of cork and cortex. The cork has several rows of radially arranged, suberized and lignified cells. A large number of pitted stone cells containing prismatic crystals of calcium oxalate occur in primary cortex. Phloem is traversed by medullary rays which are 2-4 cells wide and at the periphery are tortuous and broader. Starch grains are present in cortical and phloem parenchyma cells but absent in medullary ray cells (Shah and Bhattacharya, 1960).

Mature bark of *A. procera* is curved or channelled, the pieces varying in length and breadth and being 0·4 to 1·5 cm. in thickness. Outer surface is rough due to lenticels, wrinkles and a number of transverse and oblique cracks. Inner surface is smooth with fine striations and is buff to brown in colour. The fracture is hard and fibrous, odour indistinct and taste astringent.

In a mature bark, cork is composed of tangentially elongated cells followed by phelloderm in which solitary or small groups of stone cells are interspersed. The pericycle is composed mostly of stone cells and a few intervening fibre groups which

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get ruptured at places. The secondary phloem is composed of sieve tubes, companion cells, phloem parenchyma, stone cells, fibres, crystal fibres, phloem rays and ceratenchyma. Total ash 5·4 per cent, insoluble ash 0·05 per cent, water soluble extractive 43·4 per cent and alcohol soluble extractive is 38·0 per cent. Drug powder when treated with 1-N methanolic NaOH and mounted in nitrocellulose gives violet fluorescence under ultra-violet light. Powder turns red when treated with conc. HCl (Gupta and Kapoor, 1972).

**Chemistry :** Tannins and pseudotannins were found present in the stem-bark of *A. lebbeck*. The froth number was found to be 417. The uncorrected haemolytic index was 315 and after correlation for digitonin, it was 360 (Shah and Bhattacharya, 1960).

From the seeds of *A. lebbeck*, saponins based on echinocystic acid have been obtained (Varshney and Geeta, 1970, Varshney *et al.*, 1971, 1973) while friedelin and γ-sitosterol were identified in the bark (Tripathi and Dasgupta, 1974).

From the seeds of *A. lucida*, echinocystic acid was isolated as a sapogenin. (Chakraborti *et al.*, 1962). Repeated purification of the petroleum ether extract of the leaves of *A. lucida* gave a white solid. m.p. 168-169° and molecular formula $C_{29}H_{48}O$. A study of physical and chemical properties of the original product suggested its identity with spinasterol which was confirmed by mixed melting point determination (Banerjee *et al.*, 1965).

A colourless saponin isolated from the Maharashtrian variety of *A. procera* seeds yielded on hydrolysis, a new pentacyclic, triterpenic acid, m.p. 268-270°, acetate m.p. 288-290°, methyl ester m.p. 224-225° and acetyl methyl m.p. 280-281°. The compound was named proceric acid (Varshney and Khan, 1964).

**Pharmacology :** The alcoholic extract of the roots was found to possess anti-cancer activity against sarcoma 180 in mice. The stem bark of the plant had hypoglycemic activity in albino rats. The pods possessed anti-protozoal activity against *Entamoeba histolytica*. It also showed hypoglycemic activity in albino rats and anti-cancer activity in human epidermal carcinoma of the nasopharynx in tissue culture (Dhar *et al.*, 1968).

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## ALLAMANDA (Apocynaceae)

*A. CATHARTICA* Linn.

Mar. — Jaharisontakka

**Habitat :** Widely grown in Indian gardens, sometimes found wild all along backwaters in Travancore.

**Parts used :** Leaves and bark

**Medicinal properties and uses :** Leaves are cathartic and bark is hydragogue in ascites (Chopra *et al.* 1956).

**Chemistry*** : Plumericin and isoplumericin, the two rare lactonic principles were isolated from the acetone extracts of the stem and root bark of *A. cathartica* (Pai *et al.*, 1970).

### Reference

Pai, B.R., Subramanian, P.S. and Rao Ramdas, U. 1970. Isolation of plumericin and isoplumeric in from *Allamanda cathartica* Linn. **Indian J Chem 8,** 851.

*No reports available other aspects.

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# ALLIUM (Liliaceae)

*A. CEPA* Linn.

| | | | | | |
|---|---|---|---|---|---|
| Ben. and Hind. | — | Piyaj | Mar. | — | Kanda |
| Eng. | — | Onion | Tam. | — | Irulli, Vengayam |
| Guj. | — | Dungari-Kando | Tel. | — | Nirulli, Yeragadda |
| Mal. | — | Eerulli | | | |

**Habitat :** Cultivated throughout India

**Parts used :** Bulb.

**Ayurvedic description**

Sanskrit : *Palaandu*

Synonyms : *Teekshnagandha, ulli, mookhadooshana, shoodrapriya, krimighna, deepana, mukhagandhaka, bahupatra, vishwagandha, rochana, rudrasangyaka, yavenestha, sukanda, shikha kanda, shikaadhara, shikhaamani, shiroratna, shikhaamula, varhini.*

Properties :

| | | |
|---|---|---|
| *Rasa* | — | *Madhura, katu* |
| *Guna* | — | *Guru, snigdha, teekshna* |
| *Veerya* | — | *Ushna* |
| *Vipaaka* | — | *Madhura* |

Actions/Uses : *Vedanasthapana, shothahara, lekhana, twagdoshahara, drishtivardhaka, karnashoolahara, nasaagatarakta-pitta, raktarshas, hikka, shwaasa and kasa.*

**Medicinal properties and uses :** The bulbs are used as stimulant, diuretic, expectorant, aphrodisiac, emmenagogue and inflatulence and dysentery. It is extensively used as an articlc of food and condiment (Chopra *et al.*, 1956; Nadkarni, 1954).

*A. SATIVUM* Linn.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Rasun | Kan. | — | Bellulli |
| Eng. | — | Garlic | Mal. and Tel. | — | Velluli |
| Guj. Mar. and Hind. | — | Lasan | Tam. | — | Vellaipundu |

**Habitat :** Cultivated all over India.

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**Parts used :** Bulb and oil

**Ayurvedic description**

Sanskrit : *Rasona*

Synonyms : *Lashuna, yavaneshta, mahaakanda, grunjaka, deerghapatra, pruthupatra, ugragandha.*

Properties : *Rasa* — *Madhura, katu*
*Guna* — *Snigdha, teekshna, pichchila, guru, sara*
*Veerya* — *Ushna*
*Vipaaka* — *Katu*

Actions/Uses : *Rasaayana, vrishya, balya, medhya, swaraprada, chakshushya, varnakara, paachani, bhaghnasandhaanakara, hridrogahara, ajeernaghna, jwaraghna, kukshishoolahara, vibandhaghna, gulmaghana, kaasaghna, shwaasaghna, shoshaghna, kushtaghna, krimighna, shophaghna, arshoghna.*

**Medicinal properties and uses :** Bulb is used as a vermifuge, diuretic, carminative, expectorant and stimulant. Oil is used for skin rashes; as ear drops, in atonic dyspepsia, flatulence and colic (Chopra *et al.*, 1956, Nadkarni, 1954).

**Pharmacognosy :** It is a perennial herb having bulbs with several cloves, enclosed in a silky white or pink envelope of the skin. The foliage leaves are yellowish green and have strong alliaceous odour. Dry scales consist of 2-3 layers of rectangular cells, containing plenty of rhomboid crystals of calcium oxalate. Several vascular bundles having xylem and phloem arranged alternately are found. However, epidermis consists of smaller cubical cells. The same arrangement of tissue is also found in bulblets (Bhandari and Mukerji, 1959).

**Chemistry :** The active principle of the plant has been isolated in crystalline form. The genuine active principle of garlic named alliin was first isolated by Stoll in Basle who established its constitution as 5-allyl cysteine sulphoxide. It crystallised from water-acetone and had m.p. 163·5° (decomp). It is dextrorotatory and non-bactericidal. By the action of an enzyme alliinase present in garlic it is converted into alliin which is highly bactericidal (Bhandari and Mukerji, 1959).

A colorimetric method for the estimation of alliin in *Allium* has been described. The method is based on the formation of a pink-voilet colour complex of alliin with alloxan and measurement of the colour intensity. Alliin is a precursor of allicin (Gaind *et al.*, 1965).

**Pharmacological and Clinical Studies :** The effect of ingestion of fried onions (*A. cepa*) was studied on the changes produced in serum cholesterol, coagulation factors and fibrinolytic activity of blood after a high fat diet in 40 healthy adult males. The whole onions were lightly fried in butter with an outer coating of Bengal gram flour

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(*besan*). After ingestion of a fat rich meal, there was a significant rise in the mean serum cholesterol at 4 hours which was accompanied by lowering of fibrinolytic activity of the blood, increase in plasma fibrinogen and decreased coagulation time of blood. Addition of fried onions (60 g.) to the fat diet prevented these changes, the effect being most evident on serum cholesterol and fibrinolytic activity of the blood. Thus, it was observed that addition of onion to fatty diet could protect against changes in serum cholesterol and fibrinolytic activity of blood in individuals who react adversely to fatty diet. On the other hand, onion seemed to have little influence on individuals who do not react with a rise in serum cholesterol or fall in fibrinolytic activity after a fatty meal (Gupta *et al.*, 1966).

The effect of onion juice and essential oil of onion on alimentary hyperlipaemia induced by feeding 100 g. of butter was studied in 10 healthy subjects. Onion juice was found to have protective action against fat-induced increase in serum cholesterol and decrease in coagulation time and fibrinolytic activity (Bordia *et al.* 1974*a*).

The effect of garlic (*A. sativum*) juice as well as that of the essential oil extract of equivalent amount of garlic was studied on alimentary hyperlipaemia and on blood coagulation induced by feeding 100 g. of butter in 10 healthy subjects. Both the juice and the essential oil of garlic were found to have significant protective action against fat-induced increase in serum cholesterol and plasma fibrinogen and decrease in fibrinolytic activity as well as coagulation time (Bordia and Bansal, 1973; Bordia *et al.* 1974*b*).

Allisatin, a concentrated preparation of fresh *A. sativum* suspended in water was studied for its anti-inflammatory effect against formalin arthritis and granuloma pouch in albino rats. A dose of 200 mg./100 g. body weight per day showed slight activity against formalin arthritis but not against granuloma pouch. It had no effect on the adrenal gland. A reduction in food intake and faecal output in rats was observed (Prasad *et al.*, 1966).

*Marutasi*, a commercial preparation containing *A. sativum*, *Ricinus communis* and *Strychnos nuxvomica* had highly significant anti-inflammatory activity in both carrageenin-induced oedema and granuloma pouch in albino rats (Prasad *et al.*, 1967).

The alcoholic extract of the bulbs of *A. sativum* showed anti-inflammatory activity against carrageenin-induced rat hind paw oedema in albino rats (Bhakuni *et al.*, 1969).

Alliin, the precursor of anti-bacterial principle of *A. sativum* in the form of a syrup and an enzyme preparation in the form of powder filled in capsules were used to evaluate the clinical usefulness of the drug in the treatment of rheumatoid arthritis in 45 patients who had pain and restricted movements in one or more major joints. Thirty-two patients had relief of symptoms with this treatment. A change in the mucoprotein levels and ESR was observed in patients treated with the syrup as well as the enzyme (Sreenivasamurthy *et al.*, 1962).

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The ethyl ether extract (0·25 g./kg. orally) of the juice-expressed onions (*A. cepa*) had the maximum hypoglycaemic activity both in the normal and alloxan rabbits, compared to other extracts *viz.* ethyl ether extract of juice, steam volatile substance, petroleum ether extract and total ethyl ether extract. The hypoglycaemic effect was as significant as that of tolbutamide in alloxan diabetic rabbits also. The hypoglycaemic action of the extract may be due to the increased insulin-like activity of plasma after the administration of the extract (Augusti, 1973).

The effect of the juice of garlic and onion on glucose utilisation was studied in rabbits by using the glucose tolerance test. The hypoglycaemic effect was compared with that of tolbutamide and control groups (distilled water). Both onion and garlic were found to be effective in controlling the hyperglycaemic effect of glucose feeding as assessed by the maximum percentage fall in blood sugar levels (Jain *et al.*, 1973).

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## ALNUS (Betulaceae)

*A. NEPALENSIS* D. Don.

Hind. — Udis Punj. — Kohi

**Habitat :** Found throughout Himalayas, from Kashmir eastwards to the Khasia Hills in Assam and southwards to Cochin hills and in Burma.

**Parts used :** Bark

**Chemistry :** From the bark of *A. rubra*, taraxerone, lupeol and betulin have been isolated as major components and lupenone, taraxerol, β-sitosterol and some rare compounds such as taraxeryl acetate and glutenone as minor components. The acetone and alochol extracts contained glucose, xylose and arabinose as free sugars and fairly good amounts of leucocyanidin (Jain and Seshadri, 1971).

**Pharmacology :** The alcoholic extract of the stem bark of *A. nepalensis* was found to have hypoglycaemic activity in albino rats. The extract also had CNS depressant activity in mice as evident from amphetamine hyperactivity test (Dhar *et al.*, 1968).

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## ALOE (Liliaceae)

*A. VERA* Linn. (Syn. *A. barbadensis* Mill)

Ben. — Ghrit Kumari
Eng. — Indian aloes
Guj. — Kunvar
Hind. — Ghikanvar
Kan. — Katthaligida, lolesara, kumari
Kash. — Musabbar
Mal. — Kattavala
Mar. — Pivalaboei
Punj. — Elwa
Tam. — Kattazhai, sirukattazhai

**Habitat :** Many varieties are cultivated throughout India, some grow wild on the coasts of Bombay, Gujarat and south India.

**Parts used :** Whole plant, dried juice of leaves, pulp and root.

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**Ayurvedic description**

Sanskrit : *Kumaari*

Synonyms : *Ghritakumaari, ghritakanya, ghritakumaarika, kanya, paktikandadala, bala, vistaree, badakandinee, vishaala, pichchasambhruta, dwajabhamadhyadanda, saruna, rajeeyuta, pruthu.*

Properties : *Rasa* — *Tikta, madhura*
*Guna* — *Guru, snigdha, pichchila*
*Veerya* — *Sheeta*
*Vipaaka* — *Katu*

Actions/Uses : *Bhedinee, netrya, rasaayanee, brihmana, balya, vrishya, gulmaghna, vishaghna, pleeharogaghna, yakritvridhhihara, kaphajwarahara, grantighna, agnidagdhashamanee, raktapittahara, kushtaghna, shwaasaghna.*

**Medicinal properties and uses :** The plant is stomachic, tonic in small doses and in large doses it is purgative and indirectly emmenagogue and anthelminitic. (Nadkarni, 1954). Dried juice is cathartic and is given in constipation. Fresh juice is cooling. Pulp is useful in menstrual suppressions. Root is given in colic. (Chopra *et al.*, 1956).

**Pharmacognosy :** It is a perennial plant with glaucous green, sessile leaves having scape longer than the leaves, scaly and branched. The margin is spiny and toothed. Flowers are pendulous, imbricate and yellow. The dried juice of leaves is dark chocolate brown to black in colour. Odour is characteristic, while taste is nauseous and bitter (Bhandari and Mukherji).

Powder when mounted in glycerine shows numerous crystalline particles embedded in a brownish matrix, or greenish brown glossy masses, transparent in thin fragments like Cape aloes; or hard, dark brown, opaque masses with uneven porous fracture as in Socotrine aloes or dark reddish brown opaque masses with a nearly smooth and slightly porous fracture as in Zanzibar aloes (Bhandari and Mukerji).

**Chemistry :** Purgative property of aloes has been attributed to the presence of one or more of the three pentosides—barbaloin, isobarbaloin and betabarbaloin. The aloin content of some varieties was found to be low and of the others in the range of 27-30 per cent. The barbaloin content of Indian aloes was found to be as low as 4·24 per cent (Shah and and Mody, 1967).

**Pharmacological and Clinical studies :** The fertility rate of female rabbits was found to increase when 60 mg./kg. or more of *A. indica* powder was given intragastrically. There was also a significant increase in the litter size of the animals (Sharma *et al.*, 1972).

*Aloes compound* was found to improve fertility in 85 per cent of 250 cases of sterility. The menstrual functions also improved in 44·60 per cent of cases. It has

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been concluded that *aloes compound* is very useful in cases of functional sterility and disturbed menstrual function (Gupta 1972).

The expressed juice of *A. vera*, in the form of an ointment in vaseline has been found to hasten healing of wounds of thermal burns and radiation injury in albino rats. In addition, hydroxyproline and mucopolysaccharide contents were increased significantly in *A. vera* treated animals (Singh *et el*,, 1973).

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## ALPINIA (Scitaminaceae)

*A. GALANGA* Willd. (Syn. *A. calcarata*)

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Sugandha-vacha | Mal. | — | Chitta-ratta |
| Eng. | — | Java Galangal | Mar. | — | Kosht-Kutinjan |
| Hind. | — | Sphed-panaki-jhad | Tam. | — | Periaretai |
| Kan. | — | Dhumarashmi | Tel. | — | Pedda-dhumpa |

**Habitat :** South India and Bengal, Malabar regions. Commonly known as greater galangal or galanga major

**Parts used:** Rhizome and fruit.

**Ayurvedic description**

Sanskrit : *Malayavacha*

Synonyms : *Sugandha, ugragandha, mahaabhareevacha, gandhamoola, teekshnamoola, kulanjana.*

Properties : *Rasa — Katu*
*Guna — Laghu, teekshna, rooksha*
*Veerya — Ushna*
*Vipaaka — Katu*

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Actions/Uses : *Deepani, ruchya, hridya, suswaratwakara, kaphakaasaghna, hritshodhanee, kanthashodhanee, mukhashodhanee, shwaasaghna, brihatkushtaghna.*

**Medicinal properties and uses :** The rhizome is used in the treatment of catarrhal affections.

*A. OFFICINARUM* Hance

Ben. — Sugandha bacha Hind. — Khulinjan

**Habitat :** A native of China, commonly known as lesser galangal or galanga minor cultivated in Bengal and south India.

**Parts used :** Rhizome

**Medicinal properties and uses :** It is stomachic, stimulant and carminative (Chopra *et al.*, 1956, Nadkarni 1954).

**Chemistry :** The chemical composition of *A. officinarum* and *A. galanga* were studied. The powdered rhizomes were extracted with various solvents. Tannin and phlobaphenes were present in the alcoholic extract of both the rhizomes and starch in hot water extract. The ashes contained chloride, sulphate, phosphate, potassium and manganese. The chloroform extract of lesser galangal contained flavones like kaempferide, m.p. 221°, galangin, m.p. 215° and alpinin, m.p. 174°. Greater galangal contained no flavones. This therefore, served as one of the distinguishing features (Sastry 1961).

**Pharmacology :** The steam volatile portion of the extract of *A. galanga* rhizome stimulated the bronchial glands directly while the non-volatile portion acted reflexly through the gastric mucosa (Inamdar *et al.*, 1962) .

The alcoholic extract of the rhizomes of *A. galanga* produced hypothermia in mice. The extract also potentiated amphetamine toxicity in grouped mice (Bhakuni *et al.*, 1969).

The volatile oil of the rhizome of *A. galanga* inhibited the growth of *M. tuberculosis* in a concentration of 25 mg./ml. The oil also inhibited the growth of gram negative organisms in a concentration of 0·4 to 0·6 mg./ml. The $LD_{50}$ of the oil in guineapigs was found to be 0·068 ml./100 gm. body weight (Chopra *et al.*, 1957).

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## ALSTONIA (Apocynaceae)

*A. SCHOLARIS* (Linn.) R. Br.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Chhatin | Mal. | — | Daivapal |
| Eng. | — | Dita-bark | Mar. | — | Satveen |
| Hind. | — | Datyuni | Tam. | — | Ezhilaypatay, Aclilampalai |
| Kan. | — | Hale | Tel. | — | Palagaruda |
| Kon. | — | Santhni-rooku | | | |

**Habitat :** Widely cultivated throughout India, occurring in Sub-Himalayan tract from Jumuna eastward ascending to 1000 m.; found in Bengal and south India.

**Parts used :** Leaves, bark and milky juice.

**Ayurvedic Description**

Sanskrit : *Saptaparna*

Synonyms : *Raktachchada, vishaalatwak, sharada, vishamachchada, brihatwak, guchchapushpaka, ayugmapatra, surabhi, shaalmaleepatrika, madagandhi, uchchairika.*

Properties :
*Rasa* — *Tikta, katu*
*Guna* — *Laghu, snighda, seara*
*Veerya* — *Ushna*
*Vipaaka* — *Katu*

Actions/Uses : *Hridya, deepanee, vranaghna, raktaamayaghna, krimighna, kushtaghna, jeernajwarahara, shwaasaghna, gulmaghna, grahaneerogahara.*

**Medicinal properties and uses :** The bark is a bitter tonic, alterative and febrifuge. It is found useful in malaria. It is also used in diarrhoea and dysentery. The milky juice is applied to ulcers (Chopra *et al.*, 1956, Nadkarni 1954).

*A. VENENATUS* Brown

Sans. — Raja-adana Tam. — Pazhamunnicipattay, Pungaikeerai

**Habitat :** Occurs wild in western peninsula.

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**Parts used :** Ripe fruit

**Medicinal properties and uses :** The ripe fruits are used in syphillis, insanity and epilepsy. It is also used as tonic, antiperiodic and anthelminitic (Chopra *et al.*, 1956, Nadkarni, 1954).

**Chemistry :** From the ethanolic extract of the leaves of *A. macrophylla* three indole alkaloids have been isolated. The first alkaloid was identified as affinisine, m.p. 185°, $C_{20}H_{24}ON_2$. The second base was shown to be identical with picrinine, m.p. 223-224°, $C_{20}H_{22}O_3N_2$. The third one was a new compound designated as picralstonine m.p. 200°, $C_{20}H_{22}O_3N_2$. This alkaloid has been found to be 16-epi-picrinine (Banerji *et al.* 1972).

The alcoholic extract of the leaves of *A. macrophylla* yielded another indole alkaloid quebrachidine m.p. 257-9°, $C_{21}H_{24}N_2O_3$. The neutral fraction gave β-sitosterol (Banerji and Chakrabarty, 1973).

The alkaloids isolated in the pure state from the bark of *A. scholaris* are ditamine, echitamine, echitenine, and echitamidine and these did not evince any antimalarial activity. Total alkaloid fraction of the bark was also found quite inactive in malaria. A chemical examination of the air-dried powdered bark gave various fractions by successive extractions with different solvents. Petroleum ether extract (5·28 per cent) light yellow viscous oil—did not contain any alkaloid; ether fraction (0·221 per cent) dark brown gummy product, showed the presence of alkaloid; chloroform fraction (1·143 per cent) dark brown solid, showed the presence of alkaloids; ethyl acetate (0·28 per cent) brown gummy mass—negligible alkaloids and alcoholic fraction (4·71 per cent) redbrown, showed the presence of saponin (Chakravarti *et al.*, 1954).

A colourless crystalline product, m.p. 160°, isolated from the alcoholic extract of the bark by cold percolation, on chromatographic studies yielded 3 different products *viz.*, product A—m.p. 215°-218°, product B—m.p. 168°-169°, product C—m.p. 205°-206°. All these were non-nitrogenous and neutral in character (Chakravarti *et al.*, 1955). On further purification, product A with m.p. 223°-224°, molecular formula $C_{32}H_{52}O_2$, was identified as α-amyrin acetate, which on hydrolysis gave α-amyrin m.p. 184°. Product B was found to be a mixture of A and C. Product C m.p. 215-216°, molecular formula $C_{32}H_{52}O_2$ had properties like A and was identified as lupeol acetate which, on hydrolysis, yielded lupeol, m.p. 212-213° (Chakravarti *et al.*, 1956).

An alkaloid was also obtained from the leaves of *A. scholaris* with the molecular formula $C_{20}H_{22}N_2O_3$, m.p. 223-25° (dec.). Analysis of the functional group indicated the presence of a methoxyl, one C-methyl and only one active hydrogen atom.

The identity of the alkaloid with desacetyldesformyl picraline (picrinine) has been established from the superimposable IR spetra and undepressed mixed melting point. This appeared to be of significance as it was an intermediate for the formation of both echitamine and echitamidine skeleton (Chakravarti *et al.*, 1965).

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Dried powdered root was extracted with petroleum ether and then with chloroform. From the chloroform extract, a brown solid separated, which was soluble in water and showed 2 spots in TLC. Crystallisation from methanol yielded pure compound as fine heavy needles, m.p. 280-82° (water) and gave characteristic precipitate of silver chloride with silver nitrate solution. Its IR and UV resembled echitamine chloride ($C_{22}H_{29}O_4N_2Cl$) which was further confirmed by mixed melting point. Root bark was similarly processed to obtain echitamine chloride in greater yield i.e. 0·15 g. from 50 g. of plant material (Talapatra and Talapatra, 1967).

A simplified method of isolation of echitamine has been found out. The total yield of echitamine hydrochloride obtained in this way was 0·087 per cent from the bark (Chakravarti *et al.*, 1968).

Alstovenine, m.p. 172°, molecular formula $C_{22}H_{28}O_4N_2$, a new indole alkaloid was isolated from the alcoholic extract of *A. venenatus*. One more major alkaloid of the stem bark was also found and its structure and stereochemistry together with that of alstovenine and its congeners studied. This C-3 epimer of alstovenine has been named as venenatine, m.p. 130° (decomp.). Venenatine was found to be a monoacidic tertiary base containing two methoxyl groups and two active hydrogen atoms. Alstovenine showed striking similarity to venenatine in all its spectral and chemical properties. Venokidine is another component and it is venenatine-N-oxide (Ray and Chatterjee 1963, 1964).

From the petroleum ether fraction of the stem bark of this plant, reserpine, kopsinine and 3 other new alkaloids named venalstonine, venalstonidine and echitovinine, have been isolated. Venalstonine showed m.p. 140-142°, molecular formula $C_{21}H_{24}N_2O_2$. The structure as 6-7-dehydrokopsinine has been established. Venalstonidine had m.p. 223-225°, molecular formula $C_{21}H_{24}N_2O_3$ and echitovenine had m.p. 168-170°, molecular formula $C_{23}H_{28}N_2O_4$ (Das *et al.*, 1965).

Echitovenidine m.p. 162-163°, molecular formula $C_{26}H_{32}N_2O_4$ and (+) minovininine $C_{21}H_{26}N_2O_3$ have been isolated from the petroleum ether extract of the fruits of *A. venenata*. Venoterpine, a new monoterpenoid alkaloid has been isolated from the mature fruits of *A. venenata*. It has the molecular formula $C_9H_{11}NO$ m.p. 128-130°.

It has been reported that although the properties of venoterpine were similar to those of alkaloid RW-47 (monoterpenoid alkaloid isolated from *Rauwolfia verticillata*) the NMR spectrum differed from that of RW-47 in the CHOH region. Thus it was believed that venoterpine was possibly a stereoisomer of the monoterpine alkaloid isolated by the Australian workers (Ray and Chatterjee, 1968).

The identity of venoterpine with RW-47 and determination of their absolute configuration has been described. It was noted that the actinidine alkaloids occasionally had the opposite absolute configuration to the glycosides, implicated in indole biosynthesis and present in the same plants (Mitscher *et al.*, 1971).

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**Pharmacology :** The alcoholic extract of the stem bark of *A. scholaris* showed anti-cancer activity in $HS_1$ human sarcoma in the embryonated egg (Dhar *et al.*, 1968).

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Mitscher, L.A., Ray, A.B. and Chatterjee, A. 1971. Identity of RW-47 and Venoterpine and determination of their absolute configuration. **Experientia 27,** 16.

Ray, A.B. and Chatterjee, A. 1963. Alstovenine, a new indole alkaloid isolated from *Alstonia venenatus* R. Br. **J Indian Chem Soc 40,** 12.

Ray, A.B. and Chatterjee, A. 1964. Further studies on the major alkaloids of the stembark of *Alstonia venenata* R. Br. Structure and stereochemistry of Alstovenine and its congeners. **J Indian Chem Soc 41,** 9.

Ray, A.B. and Chatterjee, A. 1968. Venoterpine—A new monoterpenoid alkaloid from the fruits of *A. venenata* R. Br. **Tetrahedron Lett 23,** 2763.

Talapatra, S.K. and Talapatra, B. 1967. Isolation of echitamine chloride from the root and root bark of *Alstonia scholaris* R. Br. **J Indian Chem Soc 44,** 639.


# AMARANTHUS (Amaranthaceae)

*A. CAUDATUS* Linn.

Ben. and Guj. — Chuko
Hind. — Chaulai
Kan. — Dantu
Kash. — Bustanafroz
Mar. — Kaholabhoji
Sans. — Rajasiri
Tam. — Pungi kiray

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**Habitat :** Cultivated throughout India, chiefly in mountain tracts, up to 3000 m. in the Himalayas.

**Parts used :** Leaves

**Medicinal properties and uses :** Leaves are used for purification of blood, in piles and as diuretic in strangury. It is also used in scrofula and applied to scrofulous sores (Chopra *et al.*, 1956, Nadkarni 1954).

**Chemistry :** The seeds have been found to contain 10 per ceat fixed oil. Four of the six fatty acids present in the oil were identified as palmitic, stearic, oleic and linoleic acids. Out of the four sterols present in unsaponifiable matter, only two were isolated in crystalline form. One of the crystalline sterols was identified as β-sitosterol (Dixit and Varma, 1971).

**Pharmacology :** The alcoholic extract of the whole plant *A. spinosus* showed antagonism of amphetamine hyperactivity in mice (Bhakuni *et al.*, 1969).

### References

Bhakuni, D.S., Dhar, M.L., Dhar, M.M., Dhawan, B.N. and Mehrotra, B.N. 1969. Screening of Indian plants for biological activity. Part II. **Indian J Exptl Biol 7**, 250.

Dixit, V.K. and Varma, K.C. 1971. Some observations on fixed oil of seeds of *Amaranthus caudatus* Linn. **Indian Oil and Soap J 273.**

## AMRYLLIS (Amaryllidaceae)

*A. EQUESTRIS* Ait (Syn. *A. puniceum* Lamk, *Hippeastrum equestre*)

**Habitat :** Found all over India.

**Parts used :** Fresh bulbs.

**Chemistry* :** Isolation of pseudolycorine besides lycorine and β-sitosterol from *A. equestris* has been reported. Pseudolycorine was first isolated from *Lycoris radiata.* Methylpseudolycorine has also been isolated from *Narcissus pseudonarcissus* (Rao and Rao 1969).

An alkaloid isolated from the bulbs of *H. equestre* has been shown to be identical with lycorine, a pyrrolophenanthridine alkaloid by chemical and spectral studies (Ganguly and Bhattacharya, 1967).

*No reports available on other aspects.

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Another alkaloid tazettine has been isolated. Chemical constituents have been found to be influenced by the geographic distribution of the plant material (Rao and Vimala Devi, 1972).

The fresh bulbs of *H. johnsonni* were extracted with alcohol and reduced to small bulk and suspended in water. The aqueous suspension was made acidic and extracted with chloroform and chloroform-alcohol. None of the residues gave any crystalline material. The chloroform-alcohol (2 : 1) extract gave two crops of alkaloids, crop (*a*) lycorine (0·002 per cent) and a major amount of pseudolycorine (0·04 per cent). This also contained tazettine and pseudolycorine (Rao *et al.*, 1970).

A chemical examination of fresh bulbs of *H. johnsonii* showed the presence of three alkaloids, *viz.* lycorine, tazettine and pseudolycorine. The medicinal properties of the bulbs are due to the presence of alkaloids (Rao *et al.*, 1971).

The alcoholic extract of the roots of *A. rutilum* gave a crystalline substance identified as lycorine m.p. 260-62° and molecular formula $C_{10}H_{17}NO_4$ (Rao and Vimla Devi, 1964).

### References


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Rao Krishna, R.V. and Vimala Devi. 1972. Crystalline alkaloids from *Hippeastrum equestre* herb. **Planta Medica 21,** 142.

Rao, Venkata E. and Rao, Nageshwara, M. 1969. Isolation of pseudolycorine from the bulbs of *Amaryllis equestris* **Ait Curr Sci 38,** 291.


## AMMI (Umbelliferae)

*A. MAJUS* Linn.

**Pharmacology* :** Imperatorin, isolated from the fruit pericarp of *A. majus* was studied in rabbits to assess its effect on normal function of the liver by oral administration in

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the form of an emulsion with gum tragacanth. The various tests employed were bromosulphalein retention, hippuric acid excretion, albumin-globulin ratio and body weight. There was no significant difference in bromosulphalein test, albumin-globulin ratio and body weight. The hippuric acid test showed significant differences between the groups by the analysis of variance test. The decrease after treatment was highly significant for the doses employed where as control group showed an increase which was not significant. This indicated that imperatorin had a definite hepatotoxic action and that it affected the detoxicating mechanism of liver. Cephelin-cholestaerol flocculation and thymol turbidity tests were within the normal limits (Mukerjee and Mukherjee 1962).

### Reference

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## AMPHICOME (Bignoniaceae)

*A. EMODI* Lindl.

Kash. — Kaur

**Habitat :** Temperate Himalayas from Kashmir to Nepal at 700-3,000 m.

**Parts used :** Roots and leaves

**Medicinal properties and uses:** The plant is used as febrifuge and is a substitute for *chirata* (Chopra *et al.*, 1956).

**Chemistry* :** Five alkaloidal fractions and one steroidal fraction have been isolated from the roots of *A. emodi* and their Rf values were determined in paper and thin layer chromatography. The petroleum ether extract on treatment with 1 N sulphuric acid followed by ammonia and further extraction with petroleum ether yielded an oily liquid which produced colourless needle shaped crystals of its hydrochloride (an alkaloid). The alcoholic extract, on further purification, also yielded an alkaloid m.p. 158-159°, hydrochloride m.p. 135-136°, picrate m.p. 108-9° and reineckate m.p. 145-46°. The

*No report available on other aspects.

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base was water soluble. After removal of the base, the alcoholic extract was saponified and a sterol, m.p. 195-96° was isolated from unsaponifiable portion (Bhatnagar *et al.*, 1966).

## Reference

Bhatnagar, J.K., Bathala, M.S. and Jolly, S.S. 1966. Paper and thin layer chromatographic studies on some constituents of *Amphicome emodi* Lindl. **Indian J Pharm 28,** 160.

# AMURA (Meliaceae)

*A. ROHITAKA* W. & A.

| | | | |
|---|---|---|---|
| Ben. | — Tiktaraj | Tam. | — Semmaram |
| Hind. | — Harinhara | Tel. | — Sevamanu |

**Habitat:** Sub-Himalayan tract from Gonda eastwards to Bengal and Assam; Sikkim up to a height of 2000 m., Chota Nagpur, W. Ghats and adjoining hill ranges from Poona southwards to Tinnevielly up to 1200 m.

**Parts used :** Seed and bark.

**Ayurvedic description**

Sanskrit : *Rohitaka*

Synonyms : *Lohita, rakta, raktapushpa, rohinee, kushalmalee, rechana, rohee, raktaghna, katushaalmelee, pleehaghna, daadimapushpa, rohana, paarijataka*

Properties :
*Rasa* — *Katu, tikta, kashaaya*
*Guna* — *Snighda, laghu*
*Veerya* — *Sheeta*
*Vipaaka* — *Katu*

Actions/Uses : *Bhedana, pleehaghna, udaraghna, yakritroga, gulmahara, vishaapaha, bhootaapaha, vibhandapaha, kasaahara, shoolahara, rujapaha.*

**Medicinal properties and uses :** Bark is used in spleen and liver diseases, tumours and abdominal complaints. The seed oil is used as liniment in rheumatism (Chopra *et al.*, 1956, Nadkarni 1954).

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**Pharmacology*** : The alcoholic extract of the stem of *A. wallichii* showed anticancer activity against human epidermal carcinoma of the nasopharynx in tissue culture and also against Friend virus leukemia (solid) in the mouse. The extract also possessed anthelmintic activity against *Ascaridia galli* and antiviral activity against Ranikhet disease virus and vaccinia virus (Dhar *et al.*, 1968).

The water soluble fraction of the alcoholic extract of *A. rohitaka* was administered in mice in two different doses of 0·7 mg. and 1·4 mg. on alternate days to study their toxic effects. No evidence of toxic symptoms could be seen even after six such injections in animals. The extract was then administered in leukemic mice in a dose of 0·7 mg. intraperitonially for four days alternately. In the control group the appearance of tumour was noticed within six days of inoculation, whereas in the treated group tumour was not seen within 8-10 days. But the mortality rate was 100 per cent in both the groups. The total and differential counts of WBC were done on every fourth day. The size and weight of the spleen in treated group did not show much difference as compared to control group. With 1·4 mg. of the extract, the treated mice were found healthy and did not show any sign of tumour appearance till 12th day of inoculation. The total WBC count and lymphocyte percentage were less in treated groups. On cell electrophoresis, the tumour cells of treated group were found to be more motile and the movements of glandular cells were slower than normal cells but the treated group retained their motility (Prasad and Deshpande, 1968).

### References

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Prasad, G.C. and Deshpande, P.J. 1968. Effect of Rohitaka (*Amura rohitaka*) on Leukaemia. **J Res Indian Med 3,** 36.

## ANACARDIUM (Anacardiaceae)

*A. OCCIDENTALE* Linn.

Ben. — Hijlibadam
Eng. — Cashew Nut
Hind., Kon., Mar. and Guj. — Kaju
Kan. — Gerumara
Mal. — Kappa-mavu
Tam. — Mundiri
Tel. — Jaedima-midi

**Habitat :** Found in coastal forests of India especially in South.

*No report available on other aspects.

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**Parts used :** Fruits, seeds, bark and oil

**Ayurvedic description**

Sanskrit : *Shophahara*

Synonyms : *Kajuta, kajutakah, vriktarushkara, vriktapatra, guchchapushpa, parvati.*

Properties :

| | | |
|---|---|---|
| *Rasa* | — | *Madhura* |
| *Guna* | — | *Laghu* |
| *Veerya* | — | *Ushna* |
| *Vipaaka* | — | *Madhura* |

Actions/Uses : *Deepana, snehana, vrishya, raktashodhaka, hridya,*

(oil) : *Kushtaghna, shwetakushtaghna, krimighna, vishaghna, rasaayana.*

**Medicinal properties and uses :** Tar or acrid oil is used as an irritant and vesicant. Bark is alterative and astringent while fruit is used as a counter irritant. Spirit distilled from the fruit is used locally as rubefacient (Nadkarni, 1954).

**Chemistry :** The dark brown anacardic acid obtained from the nut oil after purification had the following characteristics :—Sp. Gr. (30°), 1·0001; refractive index (40°C) 1·5205, iodine value (Wij, 30 min.) 177·0. The various surface active properties have also been described (Biswas and Roy, 1958). The surface-active and bactericidal properties of sodium anacardiate were also studied (Biswas and Roy, 1961).

The studies on surface activity and unsaturation relationship in anacardic acid series were done (Biswas and Roy, 1963). The structure of its gum was also investigated. Pure gum was obtained in the form of white powder, having a low ash content. The gum was characteristic in possessing a very low content of pentosan (Biswas and Bose, 1966),

Purified gum on complete hydrolysis, broke down to L-arabinose, D-galactose rhamnose and D-galacturonic acid moieties. Autohydrolysis of the gum gave rise to a degraded gum and sugar mixture consisting of L-arabinose, D-galactose and rhamnose. Mild hydrolysis with sulphuric acid furnished D-galactose and aldobiuronic acid (Biswas and Bose, 1967).

The experiments performed with the gum demonstrated the homogeneity of the polysaccharide sample. The molecular weight of the gum has been found to be in the order of 64120. The degraded gum on hydrolysis gave aldobiuronic acid whose structure was 6-0-(D-galactopyranosyl uronic acid)-D-galactopyranose (Biswas and Bose, 1968 **a, b**).

A complete structural frame work of the gum was obtained from methylation and per-iodate oxidation studies. The gum was found to be a highly branched polysaccharide with a number of 1-3 and 1-6 type linkages. After oxidation with sodium meta

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per-iodate, the gum yielded 0·42 moles of formic acid with a simultaneous consumption of 0·86 moles of per-iodate per mole of anhydro-hexose unit. Per-iodate oxidised polysaccharide, after degradation furnished galactose, glycerol, glycolaldehyde, arabinose and glycuronic acid (Biswas and Bose, 1969).

Immunochemical and hydrolytic studies on the gum were also conducted. Cross reactivity of a homogenous sample of the gum with different types of antisera helped to deduce its characteristic structural features. Quantitative hyrolysis indicated that the two major sugars, D-galactose and L-arabinose were present in the gum in the proportion of 17 : 1 (Bose and Biswas, 1970).

**Pharmacology :** The alcoholic extract of the leaves of *A. occidentale* showed hypoglycaemic activity in albino rats. The extract also showed anti-cancer activity against Hepatoma 129 in mice (Dhar *et al.*, 1968).

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# ANAGALLIS (Primulaceae)

*A. ARVENSIS* Linn.

Guj. — Anagallide
Hind. — Jonkhmari
Punj. — Dhabbar

**Habitat :** It is a herb found throughout India ascending to a height of 2,500 m in Himalayas.

**Parts used :** Entire herb.

**Medicinal properties and uses :** It is used in gout, cerebral affections, hydrophobia, leprosy, dropsy, epilepsy and in mania (Chopra *et al.*, 1956, Nadkarni, 1954).

**Pharmacology* :** The ethanolic extract of the plant showed the most marked stimulant action on the isolated uterus of guineapigs (Jamwal and Anand, 1962).

An acetyl saponin isolated from the plant was studied for its anthelmintic activity against earthworms, leeches, cestodes and nematodes. In concentration of 1 : 1,000 and 1 : 5,000, the saponin exerted an irritant effect on earthworms and leeches. An increase in movement was followed by death. Nematodes were depressed but did not die. The saponin had a greater wormicidal activity on earthworms, as compared to well-known anthelmintics. The kymographic studies revealed similarity of action between the saponin and extract filic, both on earthworms and tapeworms (Singh *et al.*, 1955).

The alcoholic extract of the whole plant possessed anti-viral activity against *Ranikhet disease virus*. The extract also showed diuretic activity in male albino rats (Bhakuni *et al.*, 1969).

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*No report available on other aspects.

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## ANANAS (Bromeliaceae)

*A. COMOSUS* Merl. (Syn. *A. sativus* Linn.)

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Anaras | Mal. | — | Annanas |
| Eng. | — | Pineapple | Tam. | — | Parangithalai |
| Guj., Hind. and Mar. | — | Ananas | Tel. | — | Ananash |
| Kan. | — | Anasu | | | |

**Habitat :** Cultivated throughout India.

**Parts used :** Ripe and unripe fruits and leaves.

**Medicinal properties and uses :** Fresh juice of the leaves acts as a powerful purgative. It is also used as an anthelmintic and vermicide. Juice of the ripe fruit is used as anti-scorbutic, diuretic, diaphoretic, aperient and refrigerant. It helps in the digestion of albuminous substance. Juice of unripe fruit is acrid, styptic, powerful diuretic, anthelmintic and emmenagogue. In large quantities it is abortifacient (Nadkarni, 1954).

**Pharmacology* :** The juice of the unripe fruits showed promising antifertility activity in rats (Garg *et al.*, 1970).

### Reference

Garg, S.K., Saksena, S.K. and Chaudhary, R.R. 1970. Antifertility screening of plants, Part VI. Effect of five indigenous plants on early pregnancy in albino rats. **Indian J Med Res 58,** 1285.

## ANCHUSA (Boraginaceae)

*Gaozaban* is an ancient drug, used for a long time in India in the Unani system of Medicine. The crude drug is sold in the market in three forms *viz.* leaves (called *barg-e-gaozaban*), single seeded nutlets (*tukhm-e-gaozaban*) and flowers (*Gul-e-gaozaban*). Several species are known by the name *gaozaban.* Nine different plant species are sold in the commercial market as crude drug under the name *gaozaban.* These are : *Anchusa strigosa, Anisomeles malabarica, Caccinia glauca, Macrotomia benthami, Onosma bracteatum, O. hispidum, Trichodesma indicum* and *T. zeylanicum.* It has now been established that the true identity of *gaozaban* is *Anchusa strigosa* (Sitholey 1970, 1971).

*No report available on other aspects.

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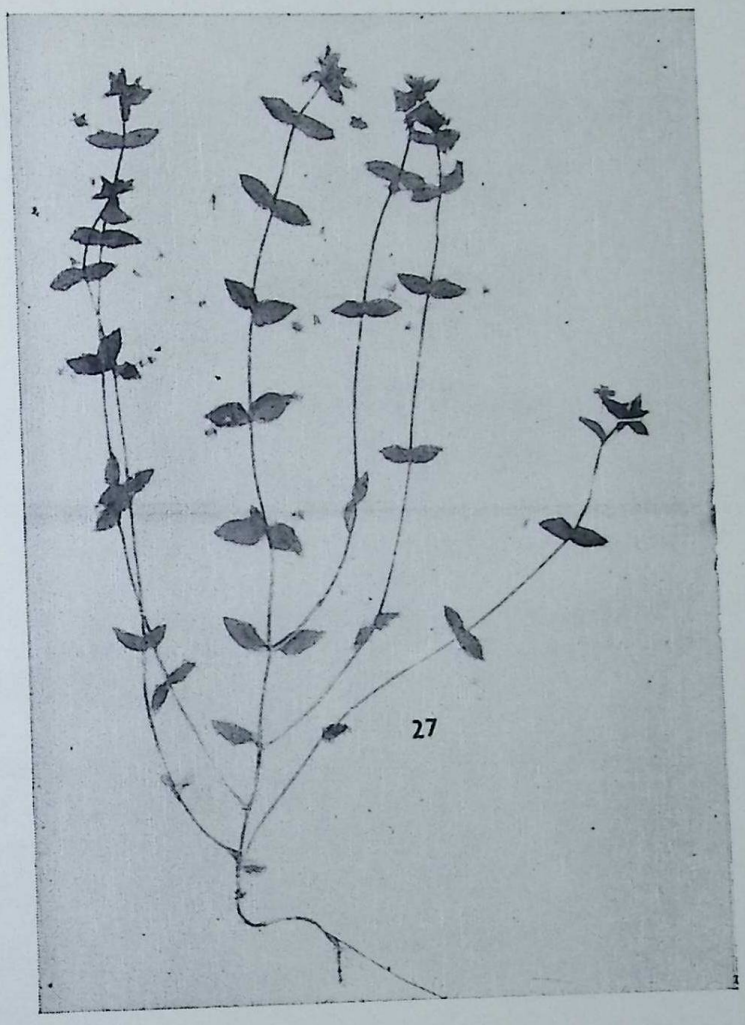


*Anagallis arvensis*

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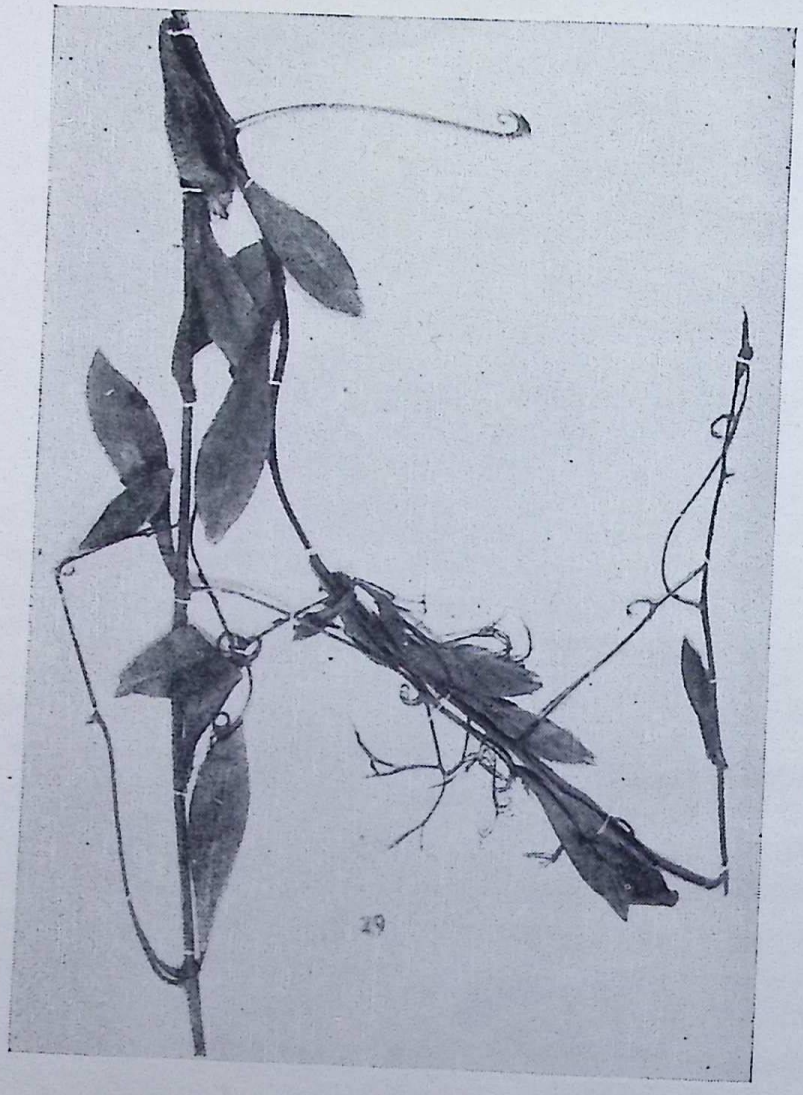

*Ancistrocladus heyneanus*

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*A. STRIGOSA* Labill.

**Habitat :** Perennial plant widely spread in South West Asia.

**Parts used :** Leaf, nutlets and flowers

**Medicinal properties and uses :** The decoction of leaves and flowers is reported to be an alternative tonic in syphilitic, leprous and rheumatic cases. It is also diuretic, demulcent and refrigerant, commonly prescribed for colds, coughs and fevers (Sitholey, 1970).

**Pharmacognosy :** After a study of several morphological characters of market samples, the drug gaozaban has been found to be *Anchusa strigosa*. A study of the characters like arrangement of the palisade layer in the lamina, the nature of the petiolar bundles, the distribution of the collenchyma etc. has led to the conclusion that the true source of gaozaban was *A. strigosa* (Qadry and Hamid, 1962, Sitholey, 1968).

The basal leaves are thick, petiolate, covered with stiff prickly hairs. The mucilage content has been found to be 20-25 per cent. The petiole has triangular outline in transection with vascular bundles arranged in an arc. The midrib has a single bundle. The lamina has a double layer of palisade tissue on each side, with the spongy mesophyll occupying one-third of leaf thickness. The upper and lower epidermis are similar in structure, having stomata on both the surfaces. The glandular hairs have 1-3 celled stalk and a globular head. The hair-base contains a cystolith-like structure. The nutlets are oblong, asymmetric with basal scar, concave with a ribbed margin. Nutlets are single seeded. Microscopically in transection, the pericarp is two layered and the testa is lined by endosperm which is represented by a single row of small nucleate cells (Sitholey, 1970, 1971).

**Pharmacology :** From the aqueous extract of the flower of *A. strigosa*, a semi-purified glycoside was isolated which had a marked hypotensive effect in dogs, cats and rats. Higher doses showed more pronounced effect with respect to magnitude and duration of fall in blood pressure as compared to lower doses. The glycoside did not exert any action on pre-atropinised or vagotomised animals. It produced predominantly depressant effect on isolated heart preparations (Garg *et al.*, 1970).

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## ANCISTROCLADUS (Ancistrocladaceae)

*A. HEYNEANUS* Wali.

**Habitat:** A woody climber.

**Parts used :** Root.

**Chemistry* :** Ancistrocladine, a new crystophenolic secondary base isolated from *A. heyneanus* has tetrahydroquinoline as basic skelton, oxidatively coupled to a reactive naphthalene nucleus. This was the first of its kind to be encountered in nature. Ancistrocladine m.p. 265-7°, molecular formula $C_{25}H_{29}O_4N$, contains three methoxyl, one aromatic methyl, two secondary methyls, one phenolic hydroxyl and a secondary amino group, thus accounting for all the hetero atoms present in the molecule (Govindachari and Parthasarathy, 1970).

Ancistrocladine has been found to represent the first isoquinoline alkaloid to possess a methyl group at C-3 (Gonvindachari and Parathasarthy, 1971).

Further chemical investigation gave more evidence for the structure of ancistrocladine. Evidence was provided for the presence of naphthalene ring at C-5 in ancistrocladine (Govindachari *et al.*, 1971*a*).

From the roots of *A. heyneanus*, a new nephthaquinone, ancistroquinone was isolated for which the structure 3, 6-dihydroxy-2-methyl-5-methoxy-1, 4-naphthaquinone was assigned. It has m.p. 222-5°, and molecular formula $C_{12}H_{10}O_5$. The structure has been confirmed by its synthesis (Govindachari *et al.*, 1971*b*).

The structure of the minor alkaloid ancistrocladinine, isolated from the roots of *A. heyneanus* was determined on the basis of spectral data and correction with ancistrocladine (Govindachari *et al.*, 1971*c*).

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*No report available on other aspects.

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## ANDRACHNE (Euphorbiaceae)

*A. ASPERA* Spreng.

It is commonly known as "Haran tutia".

**Habitat :** A small undershrub with woody root. Distributed in Persia, Arabia, tropical Africa and in India (Hooker, 1885).

**Parts used :** Root.

**Medicinal properties and uses :** Root is used for treating eye-sore and for improving eye-sight.

**Pharmacognosy :** The pharmacognostic characters of Indian and Pakistani varieties of senega have been compared and it has been proved that *A. aspera* is the source of the above drugs and are not suitable substitutes for the true senega obtained from *Polygala senega.*

Macroscopic characters : The young tap roots are slender, yellowish brown to brown surmounted by a knotty crown. Fracture is short and smooth. Its taste is acrid and tobacco-like. Older roots are bigger, dirty brown with a bigger crown. Indian senega roots are similar to the above roots.

Microscopic characters : The young root in transection shows 2-4 rows of radially arranged cork cells, phellogen is indistinct while phelloderm has several rows of slightly compressed and tangentially elongated cells. Simple starch grains, spherical, ovoid or subspherical in shape are present. The older root also shows a similar structure. The crude fibre determination, fluorescence analysis etc. have also been carried out. The studies revealed that Indian senega as well as Pakistani senega are

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obtained from *A. aspera*. The confusion existing about the botanical identity and quality of the so called Indian senega has been cleared (Shah and Khanna, 1959).

**Pharmacology :** An alkaloid isolated from the alcoholic extract of the roots of *A. aspera* was found to have stimulating action on respiration and blood pressure of dog and cat. The alkaloid showed sapsmolytic activity on the ileum of guineapig, neurotropic and musculotropic activity on rat's ileum, anti-oxytocic activity on virgin rat uterus, spasmolytic activity on tracheal muscle of cat and anti-histamine activity on guineapig's ileum. The alkaloid also showed antibacterial activity against *Staphylococcus aureus*, *S. citreus*, *Salmonella typhi*, *S. paratyphi* A, B and C, *Escherichia coli*, *Bacillus megatherium* and *B. subtilis*. Absence of toxicity of the alkaloid was revealed by studies on albino rats and mice. None of the animals died up to a dose of 10·0 mg./100 g. body weight administered orally (Derasari and Khalsa, 1966).

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## ANDROGRAPHIS (Acanthaceae)

*A. ECHIOIDES* Nees.

Guj. — Kalukariatum
Mal. — Ptumba
Mar. — Chimani
Tam. — Pitumbay

**Habitat :** Annual herb, common in south India.

**Parts used :** Whole plant

**Medicinal properties and uses :** It is a remedy for fever.

*A. PANICULATA* (Burm. f.) Nees.

Ben. — Kalmegh
Eng. — King of Bitters, Chiretta
Guj. — Kiryato
Hind. — Kiryat, Kalmegh
Kan. — Nelabevu
Mal. — Nilavaepu
Mar. — Olenkirayat
Tam. — Nilavembu
Tel. — Nelavemu

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**Habitat :** Annual herb, common in hedge rows throughout the plains of India, cultivated in gardens from Lucknow to Assam, specially in Bengal.

**Parts used :** Whole herb

**Ayurvedic description**

Sanskrit : *Bhoonimba*

Synonyms : *Yavatikta, shwetatikta, shwetakunha, shankini, sookshmapushapa, tiktaphala, yavi, yashaswni, kaalamegha.*

Properties :
*Rasa* — *Tikta*
*Guna* — *Laghu, rooksha, teekshna.*
*Veerya* — *Ushna*
*Vipaaka* — *Katu*

Actions/Uses : *Deepana, yakriduttejaka, pittashamanakari, krimighna, raktashodhaka, shothahara, swedakari, kushtaghna, jwaraghna, vishadoshahara.*

**Medicinal properties and uses :** Roots and leaves are used as stomachic, tonic, antipyretic, alterative , anthelminitic, febrifuge and cholagogue (Nadkarni, 1954).

**Pharmacognosy :** The macro and microscopic characters of the stem, leaf and floral parts of *A. paniculata* have been described. The stem is quadrangular particularly in the upper regions with four bulges arising on the four corners. The epidermis has glandular and non-glandular hairs and stomata of caryophyllaceous type. The cortex consists of collenchymatous strands, below the epidermis and in between the bulges, 4-5 layers of parenchyma cells and a distinct layer of endodermis. The phloem is characterised by the presence of acicular fibres in older plant. The vascular system is represented by an ectophic siphonostele. The leaf possesses small winged petiole. Glandular and nonglandular hairs are present on both surfaces of the lamina and caryophyllaceous type of stomata occur only on the lower surface of the leaf. The midrib varies in outline at different regions of the leaf. Cystoliths are present in the epidermal and cortical region of the stem and epidermis of the leaves, bracts, bracteoles and sepals of the flower. Small acicular crystals of calcium oxalate occur in the pith and cortical cells of the stem and the leaf. The different parts of the flower possess characteristic glandular and non-glandular hairs. The quantitative studies of the leaves such as palisade ratio, stomatal index and vein-islet number have also been determined (Prasad and Gupta 1957).

Pharmaco-botanic studies of the plant have been conducted. Stem is green, woody about 1 m in height with a tap root. Upper portion is quadrangular with four bulges while lower part is rounded. Branching is profuse, leaves are green, lanceolate, glabrous with slightly undulate margin, its apex is acuminate with base tapering. Flowers are small and solitary. Corolla is light pink in colour, hairy and bilipped. Fruit is a

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capsule, linear, oblong and acute at both ends, seeds are numerous. The plant can be raised easily as a rainy season crop (Singh *et al.*, 1972).

**Chemistry :** From *A. echioides* a new flavone echioidinin and its glucoside echioidin have been isolated. Echioidinin crystallised as greenish yellow needles m.p. 264-265° (dec.) molecular formula $C_{16}H_{12}O_5$. On the basis of spectral, degradative and synthetic evidence, echioidinin has been found to be 5, 2′-dihydroxy-7-methoxy flavone (Govindachari *et al.*, 1965*a*).

A method for the estimation of andrographolide in Kalmegh has been described. The mean values obtained from assays on four samples of Kalmegh were : 2·46, 2·36, 2·85 and 2·10 per cent of andrographolide. The values of ash content, water soluble, acid insoluble ash, and water soluble extractives have been determined. The assay procedure presented is a modification of the method described in I.P. (Shrivastava *et al.*, 1959).

A spectrophotometric method for the assay of andrographolide in Kalmegh by measuring its absorption at 226 mμ has been described. The method was found to be rapid and more accurate than the official method and other methods of assay so far reported. Samples with 0·02 mg. or less of andrographolide content can be satisfactorily estimated by this method (Gaind *et al.*, 1963).

An improved method for assay of andrographolide involving background correction due to the presence of impurities has been suggested. Further, it was shown that water extractive procedure for its isolation as given in Indian Pharmacopoeia yielded only a fraction of the available andrographolide in a given leaf (Talukdar *et al.*, 1968).

A new natural flavone, 5-hydroxy-7,8, 2′, 3′-tetramethoxy flavone was isolated from the roots of *A. paniculata.* The molecular formula was found to be $C_{10}H_{18}O_7$ and m.p. 150-51°. The compound was found to be identical with mono-0-methyl wightin in TLC, IR, UV and mass spectra studies (Govindachari *et al.*, 1969).

From a reinvestigation of *A. paniculata*, two compounds A and B were obtained. Compound A had m.p. 101°, $C_{23}H_{36}O_3$ and compound B had m.p. 170°, $C_{23}H_{38}O_8$ (Singh *et al.* 1972).

Isolation and structure of serpyllin, a new flavone from *A. serpyllifolia* has been. described. Its structure was established as 5-hydroxy-7-8, 2′, 3′, 4′-pentamethoxy-flavone by spectral and synthetic evidence. Serpyllin, $C_{20}H_{20}O_8$, is the first example of a naturally occurring flavone having the 2′, 3′, 4′-Oxygenation pattern in ring B (Govindachari *et al.*, 1968).

Wightin, a new flavone, has been isolated from the stem and roots of *A.wightiana* as yellow crystalline compound. When purified through its acetate, it formed golden yellow needles, m.p. 188°, $C_{18}H_{16}O_7$. Echioidinin has also been isolated from the plant. Wightin has been found to be, 5, 3′-dihydroxy-7, 8, 2′-trimethoxy flavone.

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It appeared to be the first example of a naturally occuring flavone with a unique 2′-3′-oxygenation pattern instead of the normal 3′-4′-pattern (Govindachari *et al.*, 1965*b*).

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# ANETHUM (Umbelliferae)

*A. SOWA* Roxb. (Syn. *Peucedanum graveolens* Benth.)

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Soolpha | Mal. | — | Chatukuppa |
| Eng. | — | Dill, Dill seed | Mar. | — | Shepu |
| Guj. | — | Surva-nubi | Punj. | — | Soya |
| Hind. | — | Sowa | Tam. | — | Satakuppay |
| Kan. | — | Sabbasige | Tel. | — | Shatakupivittulu |
| Kash. | — | Soi | | | |

**Habitat:** Cultivated in Indian gardens for culinary purposes.

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**Parts used :** Fruits.

**Ayurvedic description :**

Sanskrit : *Shatapushpa*

Synonyms : *Shataahwa, mishreya*

Properties : *Rasa* — *Katu, tikta*
*Guna* — *Laghu, rooksha, teekshna*
*Veerya* — *Ushna*
*Vipaaka* — *Katu*

Actions/Uses : *Vedanasthaapana, shothahara, vranapaachana, deepana, paachana, mootrala, jwaraghna, aartavagamanakara, stanya, krimighna.*

**Medicinal properties and uses :** It is used as carminative, stomachic, stimulant, diuretic, emmenagogue and galactogogue. Dill water from the fruit is regarded as stimulant, carminative and aromatic and promotes secretion of milk (Nadkarni, 1954).

**Pharmacognosy :** *A. graveolens* and *A. sowa* have been considered as two separate species yielding the so-called European and Indian dill respectively. Two varieties of Indian dill from Gujrat have been studied. One variety consists mostly of cremocarps and is considered to be superior and is referred as *Variyali sowa* (fennel sowa), while the other variety consists of separate mericeps and is considered to be inferior, hence cheaper and used in veterinary practice, commonly called *Ghoda sowa* (horse sowa). Both these varieties differ morphologically and have different oil composition. They are poor in dill-apiole content and have high percentage of carvone-dihydrocarvone. It has been suggested that samples containing low percentage of dill-apiole and high percentage of carvone-dihydrocarvone may be substituted for *Anethum sowa* (Shah *et al.*, 1970).

The diagnostic characters of the two varieties are summarized in the Table (Shah *et al.*, 1971**a**).

| Description | Variyali sowa | Ghoda sowa |
|---|---|---|
| Height of the plant | 50-80 cm. | 75-100 cm. |
| Roots | Thin and wiry | Stout, long and tapering |
| Transitional region | Thin, elongated with distinct purple colour | Very short, stout and without any characteristic colour |
| Leaves | Decompound with sheathing leaf bases, pinnules up to 1 cm. in length, linear and somewhat flattened | Decompound with prominent, sheathing leaf bases, pinnules 1-5 cm. in length, filiform and elongated |

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| Description | Variyali sowa | Ghoda sowa |
|---|---|---|
| Young leaf and flower buds | Both with purplish tinge | Only flower buds with purplish tinge. |
| Length of the primary peduncle | 5-11 cm. | 3-6 cm. |
| Type of fruit | Cremocarp | Mericarp |
| Shape of fruit | Ovate-oblong | Oblong |
| Size of fruit | 4·5-5·7 mm. in length<br>1·6-2·3 mm. in breadth | 4·5-5·5 cm. in length<br>2·1-2·5 mm. in breadth |
| Wings of fruit | Less prominent | Prominent |
| Weight of 100 fruits | 540-620 mg. | 240-280 mg. |
| No. of fruits in 1 g. | 171 | 376 |

**Chemistry :** The two varieties of Indian dill showed low dill-apiole content (12-15 per cent) and a high content (50-64 per cent) of carvone-dihydrocarvone (Shah *et al.*, 1971**b**).

The seeds of *A. graveolens* and *A. sowa* exhibited definite differences in their chemical components in regard to dill-apiole, coumarins and flavonoids. The first two can be used for quick distinction using small quantities of seeds. Dill-apiole, characteristic of *A. sowa* could be detected by gallic acid—$H_2SO_4$ reaction for methylene dioxy group and also by IR spectrometery, the two characteristic frequencies being 940 and 1040 $cm^{-1}$. Coumarins found in *A. graveolens* exhibited fluorescence on T.L.C. plates. Both these seeds contain petroselinic acid triglyceride and β-sitosterol glucoside m.p. 230-1° (Bandopadhyay *et al.*, 1972).

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## ANGELICA (Umbelliferae)

*A. ARCHANGELICA* Linn. (Syn. *Archangelica officinalis* Hoffm.)

**Habitat :** Grows wild in Kashmir, Himalayas at 2500-4500 m.

**Parts used :** Root, root stock and fruits.

**Medicinal properties and uses :** Root, root stock and fruits are all used as stimulant, expectorant and diaphoretic, also used as flavouring agent (Chopra *et al.*, 1956).

*A. GLAUCA* Edgw.

Punj. — Chora

**Habitat :** Western Himalayas from Kashmir to Simla at 2500-5000 m.

**Parts used :** Entire herb and dry roots.

**Medicinal properties and uses :** The herb is used as a stimulant, used in dyspepsia and constipation. Some Ayurvedic practitioners identify this with *Choraka.* It is also used as a flavouring agent (Shah *et al.*, 1972).

**Pharmacognosy :** Pharmacognostic investigations on the root, stem and leaf of *A. archangelica* and *A. glauca* have been carried out. Besides, the fruit of *A. archangelica* is also described.

Macroscopic characters—*A. archangelica* is a perennial herb bearing compound leaves. On wounding any part of the plant, a deep yellowish coloured juice with strong odour oozes out. The fruit is a schizocarp formed of a bicarpillary ovary. It is usually found in the form of separated mericarps each supported by a carpophore. *A. glauca* is also a tall perennial plant with compound leaves. A white milky juice oozes out on slight wounding of the living plant.

Microscopic characters—*A. archangelica:* A transection of the root shows normal diarch structure with normal secondary growth taking place at an early stage. Secondary phloem region is broad in which are interspersed a large number of secretory canals. Lysigenous cavities or spaces arise in the secondary phloem radiating outwards. The rays became convoluted and wavy towards the periphery of the secondary phloem as the root grows in thickness. Simple starch grains are present in the parenchyma cells.

The stem is hollow in the centre. Collenchymatous patches of cells are present at regular intervals and in between these some layers of chlorenchyma cells are observed. Secretory canals are present beneath each collenchymatous patch. Vascular bundles are connected by interfascicular fibres forming a wavy ring.

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*Angelica archangelica*

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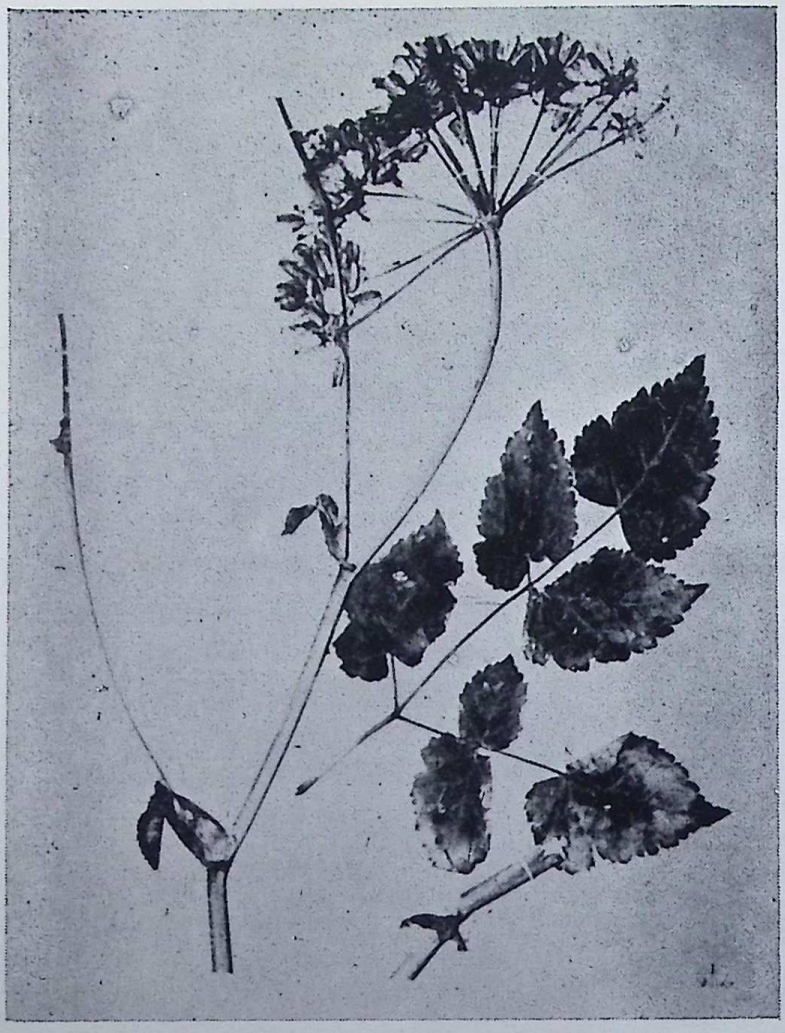

*Angelica glauca*

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The leaf petiole exhibits a wavy outline and is hollow in the centre. Secretory canals are present in the phloem region as well as beneath collenchymatous patches. The lamina shows dorsiventral structure. The midrib has projections both above and below where a collenchymatous patch of cells is seen. There are two vascular bundles in the centre. Stomata are present on the lower surface and are of anisocytic type.

The fruit shows five prominent ridges. Vascular bundles are seen below each ridge. Vittae are 18-20 in number in a mericarp, each being surrounded by epithelial cells.

*A. glauca:* The transection of root is similar to that of the above species. The parenchymatous cells are loaded with starch granules. A few patches of fibres are seen in wood zone. The stem structure follows the same pattern as in previous species except that collenchymatous patches are present beneath each groove unlike the above species where they are found beneath each ridge. The phloem tissue is capped by a zone of hard bast fibres. The petiole shows a circular to feebly wavy outline. Vascular bundles are arranged in 2-3 irregular rings. The lamina is disproportionately thin compared to the midrib. A large number of trichomes are seen on the lower surface. Preliminary phytochemical studies, ash values and fluorescence characteristics of all these plant parts have been carried out (Raina, 1974).

Pharmacognostical features of the root and rhizome of *A. glauca* have been described briefly (Shah *et al.*, 1972).

**Chemistry :** Umbelliprenin, isoimperatorin, bergapten, prangolarin, β-sitosterol and estruthol were isolated from the seeds of *A. archangelica.* From degradative experiments glycol has been identified as oxypeucedanin hydrate. The petroleum ether *viz.* isoimperatorin which, on further purification, yielded two crystalline compounds extract gave a solid and prangolarin. The mother liquor was then chromatographed over alumina giving a thick oil which, when crystallised from aqueous methanol, gave fine needles having molecular formula $C_{24}H_{30}O_3$ and m.p. 61°. Final purification after hydrolysis gave needles identical with umbelliferone, m.p. 220-21°. The phenolic constituent upon treatment with diazomethane yielded a solid, molecular formula $C_{12}H_8O_4$, m.p. 189-90°, characterised as bergapten.

The column on further elution gave another coumarin which crystallised and gave furanocoumarin ether. Acid hydrolysis of this gave a compound $C_{12}H_8O_4$, m.p. 190-91°, identical with bergapten. A solid, $C_{29}H_{50}O$, crystallised from chloroform and methanol mixture in needles, was identified as β-sitosterol. Ostruthol, molecular formula $C_{21}H_{22}O_7$, m.p. 137-38° was one of the other compounds obtained (Chatterjee *et al.*, 1967).

Ostruthol has been found to be a coumarin constituent and was isolated from the roots also. The mass spectra of both synthetic and natural ostruthol proved that ostruthol had a free isopropanol functioning group. Thus the secondary hydroxyl in oxypeucedanin hydrate was involved in ester formation confirming the structure of ostruthol (Chatterjee and Dutta, 1968a).

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Four furocoumarins viz. archangelin, prangolarin, oxypeucedanin hydrate (an α-glycol derivative) and its angeloyl ester, ostruthol and a new isocoumarin, angelicain were isolated from the petrol ether extract of the roots. The structure of new lactonic constituents, archangelin and angelicain has been demonstrated and ostruthol was synthesized. Archangelin has molecular formula $C_{21}H_{22}O_4$, and m.p. 132° and its structure has been elucidated which was in consonance with its mass spectrum.

Angelicain was isolated from chloroform extract of the defatted plant material. The structure was confirmed after examination of physical and chemical properties.

The structure and synthesis of ostruthol has also been described. The NMR and mass spectra of both synthetic and natural ostruthol were studied with a view to determine the location of the angeloyl moiety in its molecule. It was found that the secondary hydroxyl of oxypeucedanin hydrate precipitated in ester formation with angelic acid to produce ostruthol (Chatterjee and Dutta, 1968**b**).

The structure of angelicain has been revised and has been shown to contain a chromone moiety instead of an isocoumarin moiety (Kirtany *et al.*, 1973).

A flavonoid constituent has been isolated from the petroleum ether extract of root of *A. archangelica* and named as archangelenone, $C_{20}H_{20}O_5$, m.p. 148°. It has been shown to be identical with 4-prenyloxy-naringenin. This is the first report of the occurrence of a flavonoid constituent in *Angelica* (Chatterjee *et al.*, 1973).

Iso-imperatorin, prangolarin and tert-0-methyl oxypeucedanin hydrate were identified from *A. glauca* (Kapoor *et al.*, 1972).

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## ANISOCHILUS (Labiatae)

*A. CARNOSUS* Wall.

| | | | | | |
|---|---|---|---|---|---|
| Eng. | — | Thick leaved lavender | Mar. | — | Kapurli |
| Guj. | — | Ajamanupatree | Sans. | — | Ajapada, Ulpalabheda, Induparni |
| Hind. | — | Panjiri-ka-pat | | | |
| Kan. | — | Doddapatre | Tam. and | | |
| Kon. | — | Savirsambharu | Mal. | — | Karpuravalli |
| | | | Tel. | — | Rosachettu |

**Habitat:** Grows in western Himalayas, Bengal, Mysore and Malabar.

**Parts used :** Leaves and essential oil.

**Medicinal properties and uses :** Volatile oil is a stimulant, diaphoretic and expectorant. Infusion of leaves and stem is useful in coughs and colds (Nadkarni 1954).

**Chemistry :** Diosmetin, luteolin and apigenin glucosides were isolated from the leaves of *A. carnosus* (Subramaniam and Nair 1971).

**Pharmacology :** The essential oil did not inhibit the anaphylactic response of guinea-pig uterus sensitized with the white of an egg. The oil, administered in the form of an emulsion diminished spontaneous movements and caused relaxation of the intestine. It completely inhibited the contractions caused by antigenic stimulation of the sensitized ileum. An anti-histaminic activity of the oil has been found on the smooth muscles of both the uterus and the intestines *in vitro* (Sirsi and Rao, 1956).

### References

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Subramaniam, S.S. and Nair, A.G.R. 1971. Flavonoids of the leaves of *Mentha spicata* and *Anisochilus carnosus*. **Phytochemistry 11,** 452.

## ANISOMELES (Labiatae)

*A. MALABARICA* R. Br. (Syn. *A. disticha*, *A. fruticosa*)

| | | | | | |
|---|---|---|---|---|---|
| Eng. | — | Malabar catmint | Mal. | — | Karithumba |
| Kan. | — | Karithumbi | Mar. | — | Chodhara |
| Kon. | — | Kalothumbo | Sans. | — | Alamoola, Butan-kusha, vaikuntha |
| Tam. | — | Peyameratti | Tel. | — | Mogbeeraku |

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**Habitat :** Occurs in Travancore, Malabar Coast, south India and Ceylon.

**Parts used :** Entire herb, leaves and essential oil.

**Medicinal properties and uses :** Leaves are used as stomachic, carminative, diaphoretic and astringent. Essential oil is used externally in rheumatism. The plant is used in scorpion-sting and snake-bite (Chopra *et al.*, 1956, Nadkarni 1954).

**Pharmacognosy* :** The pharmacognostic characters of the root and leaf have been studied.

*Root :* The tap roots have dirty yellowish surface and whitish wood. The fracture is fibrous. The external surface has numerous longitudinal wrinkles pue scars of rootlets.

The diagnostic microscopic features of the roots are the presence of elliptical to oval shaped stone cells in phelloderm, funnel shaped medullary rays in the phloem region, relatively scanty percentage of vessels and abundant tracheids and simple starch grains in the ray cells.

*Leaf :* The leaves are simple, thick, velvette, petiolate, lanceolate to oblong, acute, rounded at the base with bluntly serrate margin. The leaf is pubescent in both surfaces.

The leaf is dorsiventral. The characteristic features are the presence of small cubical epidermal cells both in petiole as well as in midrib; long multiseriate, uniseriate glandular hairs with 3-4 basal cells; sessile glandular hairs in the lamina; diacytic stomata on both the surfaces and acicular calcium oxalate crystals in the ground tissue of petiole and midrib (Kannabiran and Krishnamurthy 1972).

**Reference**

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## ANNONA (Annonaceae)

*A. MURICATA* Linn.

Eng. — Sour Sop of America
Mal. — Mullanjakka
Mar. — Mamaphal
Tam. — Mulluchitta

*No report available on other aspects.

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**Habitat :** Grows in Bombay and Eastern India.

**Parts used :** Root bark, leaf, fruit.

**Medicinal properties and uses :** Unripe pulp is astringent and employed in intestinal atony and in scorbutic conditions. The bark is astringent and the root bark is given in ptomiane poisoning. Leaf is used an an anthelmintic and externally as suppurant (Nadkarni, 1954).

*A. RETICULATA* Linn.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Nona | Sans. | — | Ramaphalash |
| Eng. | — | Bull's heart | Tam. | — | Ramasitapazham |
| Guj., Kan. and Mar. | — | Ramphal | Tel. | — | Ramaseetapandu |

**Habitat :** Indigenous to West Indies, but now grown in Bengal, Burma and South India.

**Parts used :** Bark, fruit, seeds and leaves.

**Medicinal properties and uses :** Bark is a powerful astringent. Unripe and dried fruits are used as an astringent in diarrhoea and as anti-dysenteric and vermifuge. Kernel of the seeds is highly poisonous and the fruit is anthelmintic. Leaves are used as anthelmintic and externally as suppurant (Nadkarni, 1954).

*A. SQUAMOSA* Linn.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Ata | Mal. | — | Sirpha |
| Eng. | — | Custard Apple | Mar. | — | Sitaphal |
| Guj. | — | Anusa | Tam. | — | Sitaphazam |
| Hind. | — | Sharifah, Sitaphal | Tel. | — | Seetapandu |
| Kan. | — | Sitaphala | | | |

**Habitat :** Cultivated all over India.

**Parts used :** Leaves, bark, root, seed and fruit.

**Ayurvedic description :**

Sanskrit : *Seethaphala*

Synonyms : *Gandagatra, krishnabeeja*

Properties :

| | | |
|---|---|---|
| *Rasa* | — | *Madhura* |
| *Guna* | — | *Snigdha, laghu* |
| *Veerya* | — | *Sheeta* |
| *Vipaaka* | — | *Madhura* |

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Actions/Uses : *Jantughna, shothahara, sthambhana, hridya, raktapittashamana, vrishya, mootrala, jwaraghna, balya, daahaprashamana, brihmana.*

**Medicinal properties and uses :** Bark is a powerful astringent and tonic. Leaves are also anthelmintic. Root is purgative. Ripe fruit is a maturant. Unripe fruits are astringent and seeds are detergent (Nadkarni, 1954).

**Pharmacognosy :** The macro and microscopic characters of the stem bark of *A. reticulata* have been studied. The bark, when dried, becomes double quilled. The phloem has thin walled, tangentially elongated cells. The cork cells contain tannin. The secondary cortex occupies 30 per cent of total thickness of bark and has parenchyma cells. Groups of lignified phloem fibres with narrow lumen separate the phloem parenchyma into blocks. Lignified stone-cells, large prismatic crystals of calcium oxalate and simple as well as compound starch grains, with 2 to 4 components are present. Powder of the stem bark is greyish to chocolate brown in colour, bitter in taste and odourless. The powder, when examined under the microscope, shows cork cells, stone-cells, phloem parenchyma cells, phloem fibres either isolated in groups, simple and compound starch grains and crystals of calcium oxalate. The bark sections show the presence of an alkaloid on microchemical tests (Chaudhury, 1963).

**Chemistry :** The aporphine alkaloids anonaine, roemerine, noreorydine, corydine, (reported to have anticancer activity), norisocorydine, isocorydine and glaucine have been isolated from *A. squamosa* (Bhakuni *et al.*, 1972).

**Pharmacology :** The ether extract of the seeds of *A. squamosa* was studied for its insecticidal properties and was found to be toxic to *Musca nebulo* and *Tribolium castaneum* adults. DDT and pyrethrin were used as standard insecticides for comparison. The extract was found to act as a stomach poison against the larvae and eggs of *Bombyx mori.* The residual toxicity against *M. nebulo* was poor. An insoluble resin was formed when petroleum ether was added to the ether extract and this resin was found to be six times more toxic as contact poison against *M. nebulo* (Mukerjea and Govind, 1958).

The seeds of *A. squamosa* were found to have little oxytocic activity, although some uterotonic activity was observed in isolated tissue experiments (Mishra *et al.*, 1966).

The alcoholic extract of the aerial parts of *A. squamosa* was found to have anticancer activity against human epidermal carcinoma of the nasopharynx in tissue culture (Bhakuni *et al.*, 1969).

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## ANOGEISSUS (Combretaceae)

*A. LATIFOLIA* Wall.

Eng. — Ghati gum
Hind. — Bakla, Dhawa, Dhawra
Tam. — Vellaynagamaram

**Habitat :** A tree, mostly occurring in dry deciduous forests of India.

**Parts used :** Gum.

**Ayurvedic description :**

Sanskrit : *Dhava*

Synonyms : *Dhridatary, dhurandhara, puandutaru, peetaphala, dhavala.*

Properties : *Rasa* — *Madhura, kashaaya, katu*
*Guna* — *Laghu, rooksha*
*Veerya* — *Sheeta*
*Vipaaka* — *Katu*

Actions/Uses : *Ruchya, deepana, raktarodhaka, vranaropana, shothahara, kushtaghna, vishahara, pramehagaa, visarpahara, arshanghna, pandughna.*

**Medicinal properties and uses :** Gum has astringent action (Nadkarni, 1954).

**Chemistry :** The gum occurs in rounded tears having light yellow colour. It has a glossy fracture and is transparent internally; has a slight odour, and an insipid and mucilaginous taste. The physico-chemical properties like viscosity and castor-oil emulsifying power of gum ghatti has been studied in relation to those of gum acacia. Gum ghatti can be used in Pharmaceuticals as a substitute for gum acacia (Basu *et al.*, 1962).

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The leaves of *A. latifolia* contained hydrolysable tannins, of which gallotannin accounted for 90-92 per cent. Shikimic acid, dihydroshikimic acid, quininic acid, gallic, chebulagic and tugallic acids alongwith monosaccharides arbinose, rhamnose, fructose, glucose and galactose were present. The amino acids alanine, glycine and phenyl alanine were identified in the leaves.

The stem bark contained sitosterol, flavellagic acid, 3,3′, 4-tri-0-methyl ellagic acid, quercetin, myricetin and procyanidin alongwith gallotannins. Shikimic acid, quinic acid and free sugars-glucose and galactose were also detected. It also contained alanine and phenyl alanine. The heartwood also contained the same components as the bark except that in amino acids only phenyl alanine was found (Reddy *et al.*, 1964).

**Pharmacology :** The alcoholic extract of the stem bark of *A. latifolia* was found to have CNS depressant activity in mice. It produced hypothermia and also responded to ampheta mine hyperactivity test (Bhakuni *et al.*, 1971).

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## APHANAMTXIS (Meliaceae)

*A. POLYSTACHYA* (Wall.) Parker

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Tiktaraj | Sans. | — | Rohitaka |
| Hind. | — | Harinhara | Tam. | — | Semmaram |
| Mal. | — | Chemmaron | Tel. | — | Chawamanu |
| Mar. | — | Rohada | | | |

**Habitat,:** Found in sub-Himalayan tract, from Gonda eastwards to Bengal and Assam, Sikkim upto 2000 m., Chota Nagpur, Konkan, Western Ghats and adjoining hill ranges from Poona south-wards to Tinnevelly up to 1200 m.

**Parts used :** Leaves and bark.

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**Medicinal properties and uses :** Bark is astringent and used for toning the liver and in spleen diseases, tumours and abdominal complaints. The seed oil is used as liniment in rheumatism (Chopra *et al.*, 1956).

**Chemistry :** The petroleum ether extract of the leaves, on chromatography, yielded a neutral crystalline compound designated as aphanamixol, $C_{20}H_{36}O_2$, m.p 130°. It has been shown to be a diterpenoid of the manoyl oxide series from the studies of its spectroscopic data and other physical and chemical properties (Chandrasekharan and Chakraborty, 1968).

The petroleum other extract of the bark gave a new meliacin, aphanamixinin. Elemental analysis and mass spectrometrically derived molecular weight have settled the molecular formula as $C_{27}H_{34}O_7$, m.p. 210°. Its structure has been elucidated (Chakraborty *et al.*, 1969).

**Pharmacology :** The alcoholic extract of the stem was found to have anticancer activity against *Friend virus leukemia* (solid) in mice (Dhar *et al.*, 1968).

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## APIUM (Umbelliferae)

*A. GRAVEOLENS* Linn.

Ben. — Chanu
Eng. — Celery
Hind — Ajmoda
Mar. — Badi ajud
Punj. — Bhutghata
Tam. — Ajamoda

**Habitat :** Found at the base of the North Western Himalayas and outlying hills in the Punjab and in Western India.

**Parts used :** Roots and seeds.

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**Ayurvedic description :**

| | |
|---|---|
| Sanskrit : | *Ajamoda* |
| Synonyms : | *Bastamoda, kharaashwa, mayoori, deepya, karavee, lochamostaka.* |
| Properties : | *Rasa* — *Katu*<br>*Guna* — *Teekshna*<br>*Veerya* — *Ushna*<br>*Vipaaka* — *Katu* |
| Actions/Uses : | *Vidanhi, hridya, vrishya, balya, netrarogahara, krimighna, chardinaashana, hikkaashamana, vastirogashamanakaar.* |

**Medicinal properties and uses :** Celery prevents rheumatism and gout. The root is considered to be alterative and diuretic and given in anasarca and colic. Seeds are stimulant and cardio-tonic. They are used in bronchitis, asthma and to some extent in liver and spleen diseases (Nadkarni, 1954).

**Chemistry :** The chemical constituents of the essential oil were found to be d-limonene, d-selinene, sesquiterpene alcohols, sedanolide and sedanomic acid anhydride (Kohli *et al.*, 1967).

Two varieties of celery seeds have been examined. The anthoxanthins consisted almost completely of glycosides which have been separated into two entities called graveobioside-A and graveobioside-B. Both of them yielded apiose and glucose on hydrolysis, but the aglycone of graveobioside-A was found to be luteolin and that of graveobioside-B, chrysoeriol. By complete methylation and hydrolysis, both glycosides yielded 5, 3′, 4′-0-trimethyl luteolin, thus showing that the biose unit is in the 7-position. Graded hydrolysis removes apiose first and then glucose and hence the glycosides are apiose-glucosides. The trimethyl ether of luteolin required for comparison has been synthesized by a new procedure (Farooq *et al.*, 1953).

**Pharmacology :** The essential oil obtained from the seeds was found to possess tranquillizing activity revealed by potentiation of pentobarbital narcosis in mice and loss of conditioned avoidance response in rats. The anti-convulsant activity of the oil was revealed by its protection against supramaximal seizure threshold and metrazol seizure threshold in mice. None of the animals showed signs of neural deficit at the $ED_{50}$ levels. Maximum central activity was found to be in the fraction collected between B.P. 180° and 265° (Kohli *et al.*, 1967).

Some nitrogenous and non-nitrogenous portions of the essential oil were separated and tested for their CNS effects. Only the nitrogenous part was found to have CNS activity. It provided protection against supramaximal seizure threshold test but was not effective against convulsions induced by metrazol or strychnine. It was also found to have tranquillising activity as it potentiated pentobarbital sleeping time and produced loss of conditioned avoidance response (Kulshrestha *et al.*, 1967).

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An alkaloidal fraction isolated from the seeds of the plant also showed tranquillising activity like the essential oil. The extract reduced mortality in aggregated mice by amphetamine. It protected mice against electroshock seizure but was ineffective against metrazol and strychinine-induced convulsions (Kulshrestha *et al.*, 1970).

### References

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## ARACHIS (Papilionaceae)

*A. HYPOGAEA* Linn.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Chineebadam | Mal. and Kan | — | Nelakadale |
| Eng. | — | Earthnut, groundnut, peanut | Mar. | — | Bhuichana |
| Guj. | — | Bhoising | Sans. | — | Buchanaka |
| Hind. | — | Mungphali | Tam. | — | Verkadalai, nilakadalay |
| Kon. | — | Bhui-mug | Tel. | — | Veerusanagalu |

**Habitat :** It is a cultivated plant, grown in Pondicherry, Madras, Bombay and some parts of Bengal and Northern India.

**Parts used :** Nut, Oil and seeds.

**Medicinal properties and uses :** The fruit and oil are astringent to the bowels. The oil is aperient, emolient and used as substitute for olive oil (Chopra *et al.*, 1956).

**Chemistry* :** Calcium is known to stimulate pod formation and contribute directly to the formation of fruit coat. Calcium has been reported to inhibit the rate of sodium absorption. Studies were undertaken on the interaction of calcium-sodium in pod development. Presence of sodium ions inhibited the development of pods

*No report available on other aspects.

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in peanuts, although the vegetative growth of the plant was not effected. The seeds were grown and in the plants produced, a marked effect on the pod development was observed. The presence of sodium ions around the pegs inhibited the development of pods which may be due to inhibition in the uptake of calcium ions (Pal and Laloraya, 1967).

### Reference

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## ARECA (Palmaceae)

*A. CATECHU* Linn.

| | | | | | |
|---|---|---|---|---|---|
| Ben. Guj., | | | Kan. | — | Adike |
| Hind. and Mar. | — | Supari | Mal. and Tel. | — | Kazhangu |
| Eng. | — | Areca nut, betal-nut palm | Tam. | — | Paakkumaram |

**Habitat :** Cultivated throughout tropical India. Flourishes in the dry plateau of Mysore, Malabar and Assam.

**Parts used :** Seed or kernel, root and leaves

**Ayurvedic description :**

Sanskrit : *Kramuka*

Synonyms : *Pooga, guvaaka, deerghapaadapa, ghonta, khapura,*

Properties :

| | | |
|---|---|---|
| *Rasa* | — | *Kashaaya, madhura* |
| *Guna* | — | *Guru, rooksha* |
| *Veerya* | — | *Sheeta* |
| *Vipaaka* | — | *Katu* |

Actions/Uses : *Stambhana, vranaropana, aasyavairasyanaashana, vikaashi.*

**Medicinal properties and uses :** Fresh nut is intoxicating. Dried nut is stimulant, astringent and taenifuge. Nut is an aphrodisiac and is useful in urinary disorders. It is used as anthelmintic and emmanagogue. In veterinary medicine it is used as vermifuge for tapeworm. Also used in snake-bite (Chopra *et al.*, 1956, Nadkarni, 1954).

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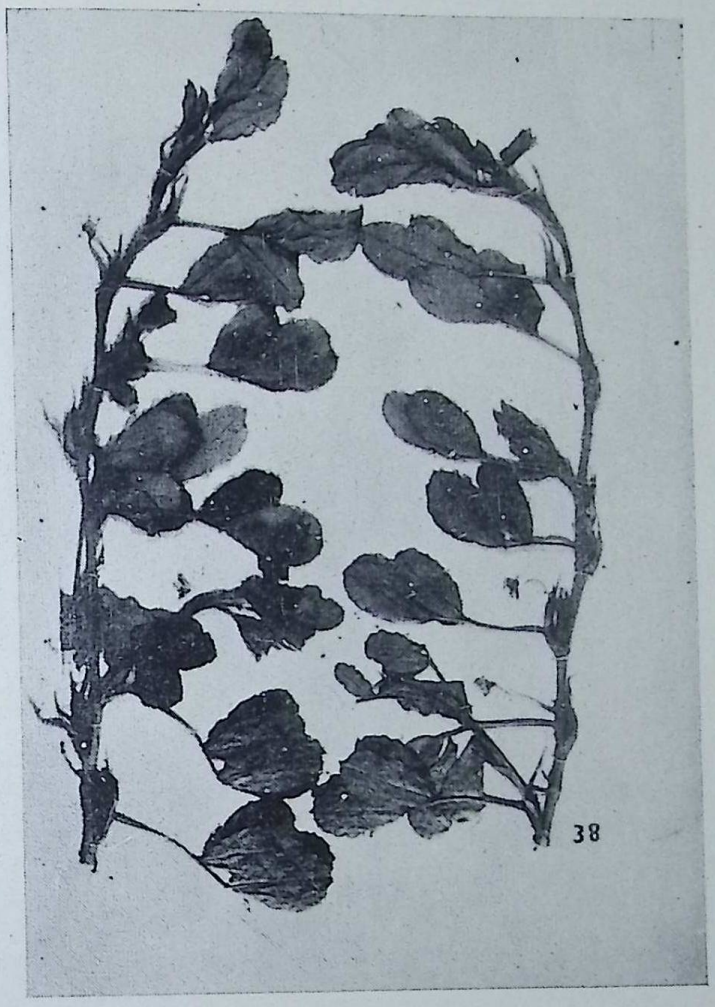


*Arachis hypogea*

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*Argemone mexicana*

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**Chemistry :** Ripe and semi-ripe areca nuts obtained from Kerala were analysed for their amino acid content and were found to have large number of amino acids both in free and combined state. The distinguishing features of amino acid make up are absence or insignificant quantity of tryptophan and methionine, presence of high percentage of proline in both free and combined forms and relative increase of free tyrosine and phenylalanine and of combined arginine in the semi-ripe and ripe nuts.

Water extracts of nuts have been examined for amino acids by paper chromatography. Traces of tryptophan, methionine and larger amounts of proline, tyrosine, phenylalanine and arginine were found (Lalithakumari and Sirsi, 1963).

In early investigations carried out in Europe, five alkaloids viz. arecoline, arecaidine, guvacoline, guvacine and arecolidine were isolated from the nut and they were considered to constitute the active principle especially as anthelmintic. But more recently, a closer study has been made of the polyphenols. A detailed analysis of young and mature nuts showed the presence of minor amounts of + catechin and high amounts of procyanidins (Nagarajan and Seshadri, 1961). In another study it was found that polymeric proanthocyanidins dominated and separation by simple means was difficult and a combination of methods was used for separation. There was considerable variation in the stage of polymerisation depending on the maturity of the nuts (Govindarajan and Mathew 1963; Mathew and Govindarajan 1964 and Mathew *et al.*, 1969) In a recent study it was found that the major ethyl acetate soluble fraction of 4 months old nuts had procyanidin dimer as the main component, of 6 month old nuts a trimer and of fully mature nuts a tetramer as the major components. These have C-C and C-O-C links forming the different polymers (Jain and Seshadri—unpublished data).

**Pharmacology :** The effect of polyphenolics obtained from fresh, unripe areca nuts was studied on rat uterus under various hormonal influence and compared with the effects obtained with alkaloidal fractions. The ethyl acetate fraction of the aqueous extract was a stimulant of low degree on all uteri but its spasmogenic activity was comparatively more on uteri treated with progesterone. The absence of uterine contraction after estrogen and stimulation after progesterone was markedly observed with polymerized fractions of the areca nut. The ethyl acetate fraction contained leucoanthocyanidins, catechin and polyphenols while the deposit contained mainly polymerised and oxidised components (Lalithakumari *et al.*, 1954).

The alcoholic extract of the nuts exerted distinct oxytocic activity on isolated rat uterus at a dose of 100 mcg (Garg and Garg, 1970). The petroleum ether and aqueous extracts of the nuts were found to have encouraging antifertility activity in rats (Garg and Garg, 1971).

The aqueous, alcoholic, alkaline and acid extracts of areca nuts caused constriction of the capillaries to varying degrees when tested by rat hind limb perfusion technique. The alkaline extract was found to be most potent in intensity as well as duration of vasoconstriction followed by alcoholic extract. The aqueous and acid extracts had mild activity (Sirsi *et al.*, 1963*a*).

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The water extract of areca nut potentiated the adrenaline action both in intensity and duration on rat hind limb preparation. Administration of a small dose of the extract during the recovery phase again caused vasoconstriction, while some polyphenols potentiated the effect of adrenaline but exerted no action on their own (Sirsi *et al.*, 1963*b*).

Arecoline, an alkaloid isolated from the nuts, in a dose of 1 mg./kg. intraperitoneally, induced slight sedation in rats at the end of five minutes in "maze learning" technique. After 30 min. the rats regained activity but they took more time to reach the goal The food was not consumed by 50 per cent of the animals. In "rotating rod" test with the same dose of arecoline, no incordination either at 5 min. or 30 min. interval was observed. The loss of appetite and the increased time for reaching the goal revealed depressant action on CNS due to arecoline (Sirsi, 1967). The route of administration of arecoline was found to be an important factor in the manifestation of the symptoms. The sedative effect predominated when given subcutaneously or intraperitoneally. Stimulation by this route was probably due to slow absorption of the drug. Arecoline also showed a low degree of MAO inhibitor activity both *in vitro* and *in vivo*. Arecoline hydrochloride was found to be a mild antagonist of reserpine at a dose of 1 mg./kg. intraperitoneally. 0·2 mg./kg. intravenous dose of arecoline hydrochloride was a very slight potentiator of thiopental hypnosis, while Areca tannins (8 mg./kg.) besides enhancing the thiopental action, also potentiated the chlorpromazine effect when given concomitantly (Sirsi *et al.*, 1966).

The aqueous extract of the nuts inhibited the growth of *Staphylococcus aureus* and *Trichophyton rubrum*, *in vitro*, while the alcoholic extract also inhibited the growth of *Escherechia coli*, *Candida*, *albicans*, *C. tropicalis* and *T. interdigitale*. Arecoline did not inhibit the growth of *Staphylococcus aureus* in 2 per cent concentration while the aqueous and ethyl acetate extracts inhibited the growth even in 1/10,000 dilution (Lalithakumari *et al.*, 1965).

The action of the extract of nuts on human blood leucocytes *in vitro* revealed that the extract had a depressing effect on normal phagocytic function (Broker and Bhat, 1952).

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## ARGEMONE (Papaveraceae)

*A. MEXICANA* Linn.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Shielkanta | Mal | — | Ponnummatum |
| Eng. | — | Tellow thistle, Prickly Poppy, Mexican poppy | Mar. | — | Kanta-dhotra |
| | | | Punj. | — | Kandiari |
| Guj. | — | Darudi | Tam. | — | Kurukkansedi |
| Hind. | — | Pila-dhatura, Shialkanta | Tel. | — | Brahmdandidandu |
| Kan. | — | Arasina-unmatta | | | |

**Habitat :** Grows wild all over India, specially from Bengal to Punjab and in Simla.

**Parts used :** Milky juice of fresh plant, seeds and mixed oil of fresh seeds and fresh root.

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**Ayurvedic description**

Sanskrit : *Swarnaksheeri*

Synonyms : *Kaanchanaksheeri, katuparni, peetadugdha, darudee, satyanashi.*

Properties : *Rasa* — *Tikta*
*Guna* — *Laghu, rooksha*
*Veerya* — *Sheeta*
*Vipaaka* — *Katu*

Actions/Uses : *Bhedaneeya, vranashodhana, raktashodhaka, shothahara, mootrala, vishamajwaraghna.*

**Medicinal properties and uses :** Root is diuretic, alterative, anodyne and hypnotic. Seeds are laxative, nauseant and emetic; yellow juice of the plant is used for dropsy, jaundice and cutaneous affections. Oil is purgative. (Chopra *et al.*, 1956, Nadkarni, 1954).

**Pharmacognosy :** Mustard seeds are often adulterated with the seeds of *Argemone* species i.e. *A. mexicana* and *A. ochroleuca*. Distinguishing macro and microscopic characteristics of *Argemone* seeds have been described. The TLC patterns of pure mustard oil and oil adulterated with *Argemone* seeds have also been recorded (Bhatnagar and Puri, 1970).

**Chemistry :** Chemical analysis of the powdered roots and stem revealed the presence of 0·125 per cent total alkaloid which consisted of protopine 0·084 per cent and berberine 0·041 per cent. Besides the alkaloids, other constituents found were tannins 1·10 per cent, resin 1·75 per cent and an unidentified toxic principle in the oil (Bose *et al.*, 1963).

The total alkaloids of the seeds have been fractionated. The crushed seeds were exposed for a week and fractionated by hydrogen chloride resulting in seven fractions which were all toxic (Chakravarti *et al.*, 1954).

A spot test has been developed for detection of micro quantities of argemone oil in mustard oil. This is a highly sensitive test developed for detection of traces of argemone oil in mustard oil by paper partition chromatography (Chakravarti *et al.* 1959).

**Pharmacology :** The total alkaloidal fraction produced a fall in blood pressure of anaesthetized dogs at a dose of 0·1 mg./kg. and above. This response was not modified by atropine, anti-histamines or adrenergic blocking agents. Protopine fraction produced a rise in blood pressure in smaller concentrations and a fall in a dose of 1 mg./kg. and above. Berberine fraction produced a fall in all the concentrations. The total alkaloidal fraction in 2 doses of 1·0 mg./kg. inhibited both auricles and ventricles *in situ* in dogs. A depression in rabbit's heart was also observed *in situ* and as well as in isolated organ. Protopine fraction produced a slight stimulation even at a

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dose of 25 mcg./kg. whereas berberine fraction was found to be a myocardial depressant. The respiration was stimulated by total alkaloidal fraction when given intravenously. At higher concentration it antagonised barbiturate-induced respiratory depression. Berberin produced initial stimulation followed by depression. A stimulation of tone and peristaltic movements was observed in the intestines of anaesthetized dogs and rabbits in a dose of 0·05 mg./kg. by total alkaloidal fraction and also the individual fractions. The total alkaloids also stimulated the smooth muscles and antagonised the action of acetylcholine, histamine and 5-hydroxy tryptamine. The oxytocic action was found similar to that of pitocin (Bose *et al.*, 1963).

Argemone oil was tested for its carcinogenicity in combination with three different types of edible oils : (1) imported soyabean oil (*ii*) authentic mustard oil and (*iii*) market samples of mustard oil. The studies were carried out using two strains of mice 'C 17' (specially developed for testing environmental carcinogens) and inbred 'Swiss'. Three routes of administration were used *viz.* cutaneous application, subcutaneous injections and oral feeding by stomach tubing. The results indicated that pure argemone oil did not exhibit any carcinogenic effect on mouse skin or subcutis. It showed some carcinogenic effect at 0·25 per cent and 0·5 per cent concentrations when tested with authentic mustard oil. A marketted mustard oil sample under test proved to be weakly carcinogenic. Addition of 1-2 per cent pure argemone oil to a sample of this marketted mustard oil accelerated the process of carcinogenesis indicating a co-carcinogenic effect. These studies indicated that besides argemone, there was the possibility of the prsence of other hazardous contaminants in market samples of mustard oil (Ranadive, 1972).

Acute and chronic toxicity with argemone oil was determined in rats. $LD_{50}$ was found to be 1·1 ml./kg. (oral ) and 1·3 ml./kg. (subcutaneously). The doses of 1/500 and 1/1000 $LD_{50}$ induced toxic changes in albino rats. Biochemical studies indicated that the ratio of albumin to globulin was observed. Histopathological findings showed that myocardial necrosis and toxic liver changes of various degrees were induced by argemone oil and that the oil was definitely toxic to albino rats even at a dose 1/1000 $LD_{50}$ (ICMR Bull. 1971).

Investigations were undertaken to develop a method for quantitative estimation of argemone oil in any edible oil, to elucidate the biological features of argemone oil, toxicity in experimental animals from the point of view of fixing safe limits of contamination and to examine the nature of the toxic principle in argemone oil.

A study of fluorescence characteristics of the alkaloid isolated from the oil by means of TLC showed that it exhibited an absorption maximum at 340 mμ and excitation maximum at 470 mμ and these characteristics formed the basis for the method. Work with the test mixtures of argemone oil in groundnut oil showed that the intensity of fluorescence was linear and proportional to the argemone oil upto the tested concentration of 1 per cent and thus the method was sensitive for argemone oil concentration as low as 0·1 per cent. A visual method based on the same lines has also been developed.

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Studies conducted to elucidate the nature of the potentiating factor present in the argemone oil indicated that the presence of alkaloids together with the acid or neutral fraction of the oil is necessary to produce toxic symptoms (ICMR Bull., 1971).

The alcoholic extract of the entire plant *A. mexicana* was found to have anti-viral activity against *Ranikhet disease virus* (Dhar *et al.*, 1968).

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## ARGYREIA (Convolvulaceae)

*A. TILIAEFOLIA* Wight.

**Chemistry*** : A semisolid mass was obtained from the neutral fraction of ethanolic extract of the seeds. After purification it crystallised having m.p. 285-290° and was insoluble in most common organic solvents but soluble in pyridine and dioxane. The compound was found to be sterolin with molecular formula $C_{35}H_{60}O_6$. On hydrolysis it gave a sterol $C_{29}H_{50}O_3$, identified as β-sitosterol. The sterolin was thus found to be identical with β-sitosterol glucoside (Chakravarti *et al.* 1962).

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*No reports available on other aspects.

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## ARISAEMA (Araceae)

*A. CURVATUM* (Roxb.) Kunth. (Syn. *A. tertuesum* Schott).

Nep. — Birbanka

Punj. — Don

**Habitat :** Found in temperate and subtropical Himalayas from Simla to Sikkim and Bhutan at 2,500 m., Khasia hills, Manipur, Chota Nagpur, Ranchi, Konkan, Rampa Hills at 1,500 m., Horsley Konda at 1,500 m., Western Ghats at 1,000-2,500 m.

**Parts used :** Entire plant, roots and seeds.

**Medicinal properties and uses :** Plant is poisonous while the seeds are given with salt for colic in sheep. Roots are used to kill worms which infest cattle. Root is also anthelmintic (Chopra *et al.*, 1956; Nadkarni, 1954).

**Chemistry* :** The presence of carbohydrate (D-glucose) was confirmed by comparison with authenic samples and coincidence chromatography in the bulbs of *A. curvatum.* (Satya Prakash and Sinha, 1972).

### Reference

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## ARISTOLOCHIA (Aristolochiaceae)

*A. BRACTEATA* Retz.

Guj. — Gudhatee
Eng. — Worm-killer
Hind. — Kiramar
Kan. — Sannajali-hullu
Mal. — Atu-tinlap
Mar. — Gandhani
Tam. — Adutinndapalai
Uriya — Paniri

**Habitat :** It is a herb, growing along the banks of the Ganges and in southern India.

**Parts used :** Seeds, leaves and entire plant.

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*No reports available on other aspects.

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**Ayurvedic description :**

Sanskrit : *Ishwari*

Synonyms : *Nakuli, ahigandha, sunanda*

Properties : *Rasa* — *Tikta, katu, kashaaya*
*Guna* — *Laghu, rooksha, teekshna*

Actions/Uses : *Vishaghna, vranashodhana, shothahara, vedanaasthapana, deepana, anulomana, graahi, krimighna.*

**Medicinal properties and uses :** Whole plant material is used an an anthelmintic, purgative, emmenagogue, alterative, and antiperiodic. It is also beneficial in the treatment of snake-bites and is given with castor oil in colic and amenorrhoea, dysmenorrhoea, tedious labour, intermittent fever and worms. It is also given in syphilis, gonorrhoea and skin diseases (Nadkarni, 1954).

*A. INDICA* Linn

Ben. — Isharmul
Eng. — Indian birthwort
Guj. — Sapasan
Hind. — Isharmul
Kan. — Ishwariberu
Kon. — Sapsikaddula
Mal. — Eshvaramulla
Mar. — Sapsanda
Sans. — Ahiganda, Sunanda
Tam. — Isvaramulisedi
Tel. — Ishveraveru

**Habitat :** Found all over India.

**Parts used :** Root, rhizome and leaves.

**Medicinal properties and uses :** Root is tonic, stimulant, emmenagogue, alexiteric and anti-arthritic. Leaves are stomachic, tonic and anti-periodic (Nadkarni, 1954).

**Chemistry: :** Chemical investigations on the roots and stem of *A. bracteata* revealed the presence of alkaloids. Aristolochic acid was isolated from the defatted material with a yield of 0·01 per ccnt (Dutta and Sastry, 1959).

From the leaves and fruits of *A. bracteata*, ceryl alcohol and β-sitosterol have been isolated in addition to aristolochic acid and potassium chloride. The roots contained potassium chloride and nitrate as the major constituents besides the bitter principle, aristolochic acid, a yellow micro-crystalline compound, m.p. 275-277°, with molecular formula $C_{17}H_{11}O_7N$. The alcoholic extract of the roots gave another crystalline mass, potassium nitrate. The content of ceryl alcohol was maximum in leaves (0·38 per cent) and only 0·12 per cent in fruits (Sastry, 1965).

An alkaloid aristochine from *A. indica* was reported and its identity was confirmed as 1-curine. The alkaloid had the molecular formula $C_{36}H_{38}O_6N_2$ (Govindachari and Viswanathan, 1967).

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It has been claimed that ishwarone $C_{15}H_{22}O$, m.p. 57°, isolated from *A. indica* was a novel tetracyclic sesquiterpene ketone based on eremophilane skeleton, was the first one of its kind to be found in nature (Ganguly *et al.*, 1969). The absolute stereochemistry of ishwarone has been studied by chemical correlation with (+)—nootkatane (Govindachari *et al.*, 1969). Based on spectral and chemical evidence, the structure for ishwarone has been established (Fuhrer *et al.*, 1970).

Two new sesquiterpene hydrocarbons, ishwarane and aristolochene were isolated from the roots of *A. indica* and their structures established. The only residue from the hexane extract of the root gave ishwarane, $C_{15}H_{24}$, b.p.80-82°/1mm. Later fractions gave aristolochene, $C_{16}H_{24}$, b.p. 85°/0·5 mm. Thus it was found that ishwarane is the first tetracyclic sesquiterpene hydrocarbon based on the eremophilane skeleton and aristolochene represents structurally the simplest member of the biogenetically interesting and steadily growing group of eremophilane type of sesquiterpenes (Govindachari *et al.*, 1970).

A new tetracyclic sesquiterpene alcohol ishwarol $C_{15}H_{24}O$, b.p. 110°/1 mm., was isolated from the roots of *A. indica* and assigned the structure on the basis of spectral data and correlation with the known tetracyclic sesquiterpene ketone, ishwarone. The NMR spectrum of ishwarol has a close resemblance to ishwarone and showed the presence of a cyclopropane ring, two tertiary methyl groups and one secondary methyl group (Govindachari and Parthasarathy, 1971).

**Pharmacology :** The alcoholic cold water and hot water extracts of the roots and stem of *A. bracteata* produced contractions on the uteri of virgin rat and guineapig. The stimulating effects observed on these tissues were found to be due to potassium chloride present in the above extracts and not due to any other constituents like tannins, resins, and alkaloids (Dutta and Sastry, 1959).

A crystalline water soluble base isolated from the leaves of *A. bracteata* produced a dose-dependent fall in blood pressure in anaesthetised dogs and cats when ad-administered intravenously. The negative chronotropic effect could not be surmounted either with atropine or excess of calcium. A relaxant effect on isolated strips of intestine was observed which persisted for more than 30 minutes and was not annulled by treatment with atropine (Venkatasubbu—Personal communication).

The juice of *A. indica* was found to have a relaxant effect on the rhythmic contractions of uteri of rats and human beings. It had a non-specific antispasmodic effect on spasms induced by acetylcholine, barium chloride and pitocin at a concentration of 4 mg./ml. (Tewari *et al.*, 1966).

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## ARNEBIA (Boraginaceae)

*A. NOBILIS* Rachinger

**Chemistry :** The roots of *A. hispidissima* yielded a dye which is called *Ratanjot*. On extraction with petroleum ether, the roots yielded a red oil which after purification through copper salt yielded the pigment as a glittering red solid, m.p. 148-49°. It resembled alkannin in all respects except optical rotation. It was therefore (±) alkannin, also called shikalkin (Jain and Mathur, 1965).

The hexane soluble fraction of the ethanol extract of *A. nobilis* on chromatography yielded four dark red cyrstalline products, provisionally designated as A-1, $C_{21}H_{22}O_6$, m.p. 116-117°; A-2, $C_{21}H_{24}O_7$, m.p. 92-94°; A-3, $C_{18}H_{18}O_6$, m.p. 104-105° and A-4, $C_{14}H_{16}O_5$, m.p. 146°. Out of these, A-4 was characterised as the naphthaquinone alkannin originally isolated from *Alkanna tinctoria* and subsequently from *Onosma echoides* and *Arnebia hispidissima*. A-3 and A-1 were characterised as alkannin monoacetate and as alkannin β-dimethylacrylate (Shukla *et al.*, 1969).

Silica gel chromatography of the fraction from *A. nobilis* possessing antibiotic and anticancer activities yielded three new naphthaquinones alongwith alkannin and other compounds reported earlier (Shukla *et al.*, 1971).

**Pharmacology :** The antibiotic activity of the alkannin derivatives obtained from roots has been established. A-2 compound would appear to be the most potent, inhibiting the growth of gram-positive bacteria (*Staphylococcus aureus* and *Bacillus subtilis*) and fungi (*Candida albicans* and *Cryptococcus neoformans*) at a concentration of 6·25 mcg./ml. (Shukla *et al.*, 1969; Bhakuni *et al.*, 1969).

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## ARTABORTRYS (Annonaceae)

*A. ODORATISSIMUS* R. Br. (Syn. *A. hexapetalus* Bhandari)

| | | | |
|---|---|---|---|
| Ben. | — Katchampa | Tam. | — Manoranjitam |
| Mar. | — Hirva Champa | Tel. | — Manoranjidamu |
| Sans. | — Harachampaka | | |

**Habitat :** Grown in Indian gardens.

**Parts used :** Leaves, flowers and fruits.

**Medicinal properties and uses :** In Malay Archipelago, the decoction of the leaves is given for cholera. Essential oil of flowers is used in perfumery (Chopra *et al.*, 1956).

**Chemistry and Pharmacology :** Chemical studies on the various extracts of the fruits of the plant revealed the presence of fixed oil, volatile oil, glycosides and resin. The alcoholic extract was found to contain volatile oil, glycosides and calcium. The alcoholic extract showed cardiac depressant effect followed by stimulant effect on isolated frog's heart. Only stimulant effect was observed in dog's heart *in situ* and rabbit's isolated heart. In anaesthetized dogs, a hypotensive effect was observed, although in some experiments, initial fall followed by rise in blood pressure was observed. The extract had a relaxant effect on isolated ileum of rabbit. A spasmogenic effect on the smooth muscle of uterus was also observed (Trivedi *et al.*, 1971).

The leaves were found to have antifertility activity in albino rats. The drug was safe and its effect was of long duration (Chakrabarti *et al.*, 1968).


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Trivedi, C.P., Saxena, S.P. and Emmanuel, J. 1971. Preliminary phytochemical and pharmacological studies on *Artabortrys odoratissimus* (*Champa*). **Indian J Med Res 59,** 635.

## ARTEMISIA (Compositae)

*A. SCOPARIA* Waldst. and Kit.

Mar. — Churisaroj, Danti  Punj. — Dona, Jhan

**Habitat :** Grows over vast streches of uncultivated land in some parts of North India, specially the plains of Jammu, Punjab and Uttar Pradesh upto an elevation of 3,600 m in Himalayan localities.

**Parts used :** Whole plant, seed and flowers.

**Ayurvedic description**

Sanskrit : *Paraseekayavaani*

Synonyms : *Yavaani, chauhaara, keetamariyavaani*

Properties : *Rasa* — *Tikta, katu*
*Guna* — *Laghu, rooksha, teekshna*
*Veerya* — *Ushna*
*Vipaaka* — *Katu*

Actions/Uses : *Graahi, deepana, vedanaasthapana, shothahara, vranaropna, krimighna, jwaraghna.*

**Medicinal properties and uses :** Plant is used for earache and its smoke is considered good for burns. Infusion of the plant is purgative (Chopra *et al.*, 1956).

**Chemistry :** The pale yellow essential oil obtained from *A. scoparia* has a characteristic eugenol odour. The oil on examination gave the following data :— acid value 4·68, ester value 4·7, ester value after acetylation 55·54, carbonyls 5·99 per cent, phenols (as eugenol) 30·0 per cent. Eugenol was obtained by the alkali treatment of the oil. The phenol-free oil was chemically examined with the help of column, thin layer and gas chromatography. The following components have been confirmed : eugenol, geranyl acetate, dillapiole, butyraldehyde, methyleptenone and carvone. The oil was found to contain 30 per cent eugenol (Thappa *et al.*, 1968).

From the petroleum ether extract of *A. scoparia*, scoparone, scopoletin and an unidentified compound have been isolated in crystalline form (Jamwal *et al.*, 1970).

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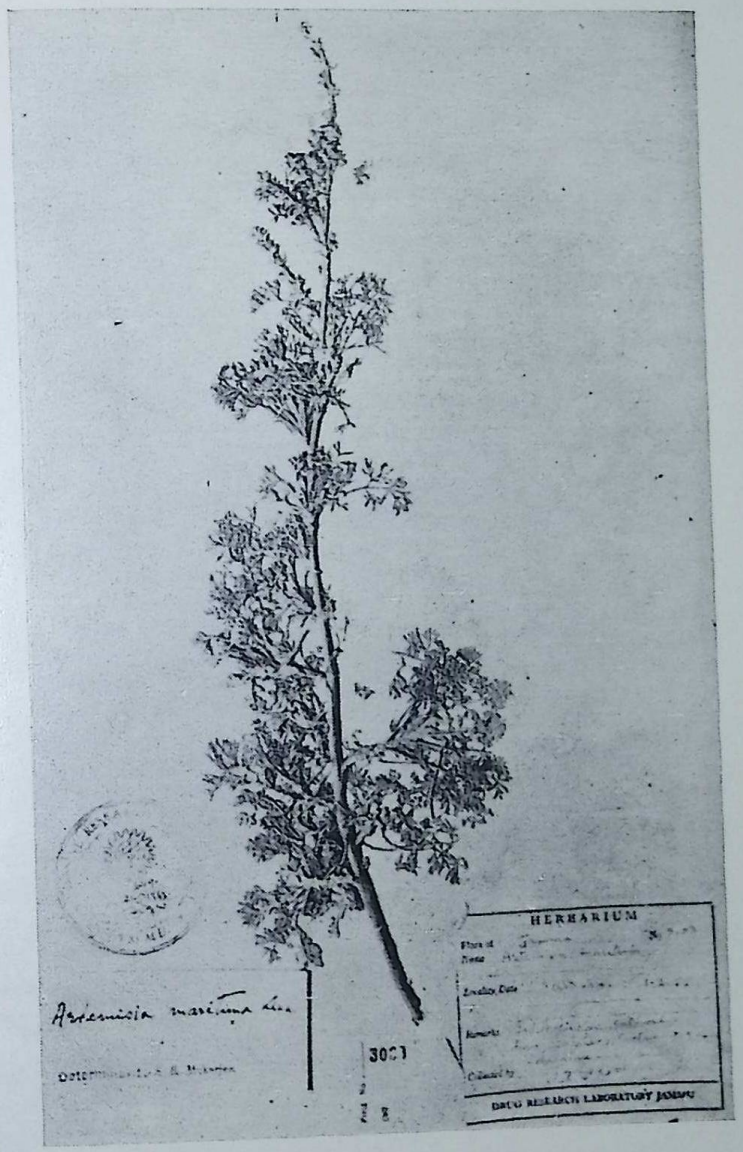


*Artemisia meritima*

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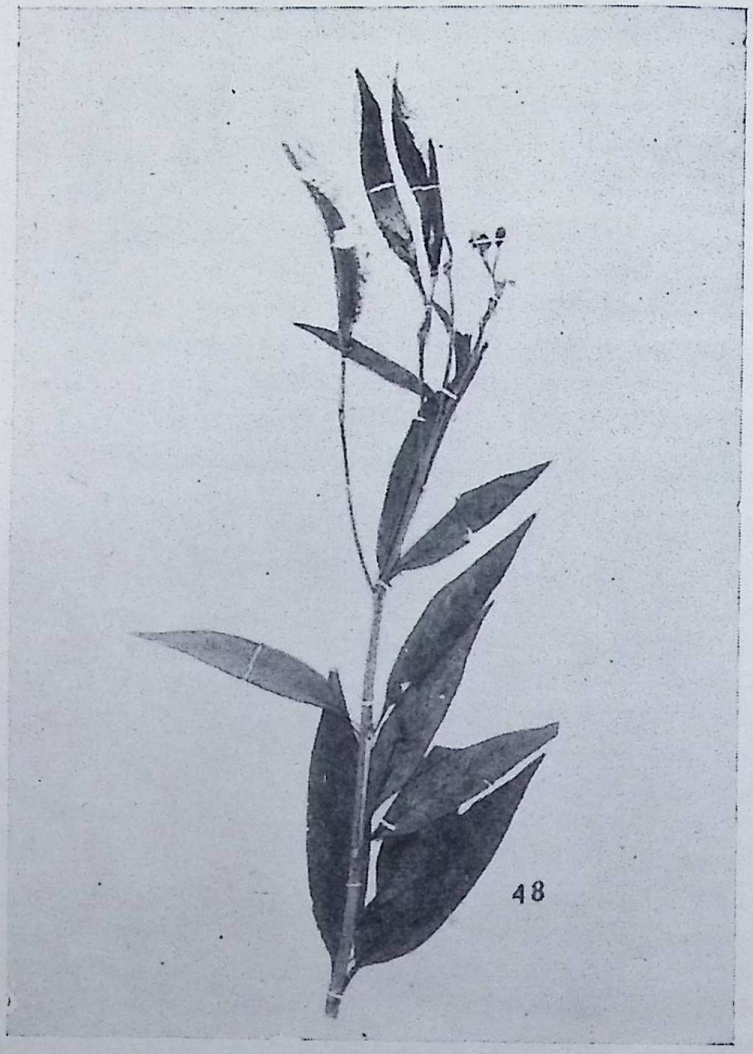


*Asclepias currasavica*

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The petroleum ether extract of *A. vulgaris* furnished a new crystalline pentacyclic triterpene alcohol, fernenol, m.p. 194°, molecular formula $C_{30}H_{50}O$. Its structure has been established (Kundu *et al.* 1966).

**Pharmacology :** With an intravenous dose of 5-20 mg./kg. of scoparone, a marked fall in blood pressure was observed in anaesthetised dogs, cats and rats. The effect was dose-dependent and appeared immediately after injection of the drug. The hypotensive effect was also observed after intra-duodenal administration of scoparone (25-30 mg./kg.) in anaesthetised dogs. The contractions of the nictitating membrane of cats, induced by electrical stimulation of preganglionic sympathetic nerve, was inhibited by intravenous injection of 10-15 mg./kg. of scoparone. An intraperitoneal dose of 20 mg./kg. of scoparone in rats and mice produced diminution of locomotor activity. A higher dose (40-80 mg./kg. I.P.) produced a depression of central nervous system. Scoparone prolonged the sleeping time induced by pentobarbitone and ether in rats and caused fall in body temperature. A dose of 20 mg./kg. I.P. caused blockade of conditioned avoidance response. A slight analgesia in rats was observed with the drug. Scoparone (20 mcg/ml.) caused peripheral vasodilation and showed anti-spasmodic and relaxant effect on smooth muscles of rabbit duodenum and guineapig ileum (Jamwal *et al.*, 1972).

The aqueous extract of the fruits of *A. vulgaris* caused immediate rise of both systolic and diastolic blood pressure of anaesthetized dogs. The respiratory rate was increased but amplitude of contraction was diminished. The drug showed direct stimulant action on frog myocardium *in situ* and isolated. A direct spasmogenic action on guineapig and rabbit gut was shown by the extract. It also showed definite anthelmintic activity against tapeworms (Misra *et al.*, 1968).

Santonin, an anthelmintic, isolated from *A. meritima* was found to be a potent antifertility agent in mice. A dose of 4 mg./100 gm. daily for 15 days before and 15 days during mating rendered 87 per cent of the mice infertile whereas 6 mg./100 gm dose for the same period produced sterility in 60 per cent and infertility in 100 per cent of animals. It also prolonged the duration of oestrus cycle, the dioestrus phase and delayed the onset of matings (Sareen *et al.*, 1961).

Studies on hormonal and anti-hormonal effects of santonin in albino mice revealed that it had no androgenic, oestrogenic, anti-oestrogenic, progestational and anti-progestational effects. It did not antagonise the effect of exogenous chorionic ganadotropin (Misra *et al.*, 1961).

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## ARTOCARPUS (Moraceae)

*A. CHAPLASHA* Roxb.

Ben. — Chaplash

**Habitat :** A tall deciduous tree, found scattered in the moist forests in the sub-Himalayan tract, from Nepal eastwards to Bengal and Assam and Southwards to Burma and Andamans.

**Parts used :** Bark.

*A. INTEGRIFOLIA* Linn. (Syn. *A. heterophyllus* Lamk).

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Kanthel | Kon. and Mar. | — | Phanas |
| Eng. | — | Indian Jack-tree | Mal. | — | Pilav |
| Guj. | — | Manphanasa | Tam. | — | Pahapazham |
| Hind. | — | Katahara, Kathal | Tel. | — | Panasa |
| Kan. | — | Halasu | | | |

**Habitat :** Cultivated all over India.

**Parts used :** Fruit, seeds, leaves, root and the milky juice of plant.

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**Ayurvedic description**

Sanskrit : *Panasa*

Synonyms : *Kantakeephala, shwaasaapaha, garbhakantaka.*

Properties : *Rasa* — *Madhura*
*Guna* — *Snigdha*
*Veerya* — *Sheeta*
*Vipaaka* — *Madhura*

Actions/Uses : *Balya, shukrapravardhaka, raktapittahara, kshatakshayahara.*

**Medicinal properties and uses :** Ripe fruit is demulcent, nutritive and laxative, while unripe fruit is astringent (Nadkarni, 1954).

**Chemistry :** Chemical examination of the stem bark of *A. chaplasha* yielded β-sitosterol (Mahato *et al.*, 1966*a*). The petroleum ether extract of the bark of *A. chaplasha* yielded lupeol acetate and cycloartenyl acetate. By chromatographic techniques the following products were obtained : lupeol acetate m.p. 216-217°, $C_{32}H_{52}O_2$. On hydrolysis and subsequent hydrogenation, lupeol acetate afforded lupanone, m.p. 203-204°, cycloartenone $C_{30}H_{48}O$, m.p. 107-108°, cycloartenyl acetate, $C_{25}H_{54}O_2$, m.p. 131-132°, cycloartenol, $C_{30}H_{52}O$, m.p. 99-100° (Mahato *et al.*, 1967).

The leaves of *A. chaplasha* were found to contain lupeol acetate, cycloartenone and cycloartenyl acetate from petroleum ether eluate and epifriedelinol m.p. 277-80°, $C_{30}H_{50}O$ from benezene eluate. β-sitosterol was obtained from benzene—ether eluate (Mahato *et al.*, 1968).

Synthesis of (±) 0-trimethyl cyanomaclurin in *A. integrifolia* has been described (Bhatia *et al.*, 1966).

Lupeol acetate and α-amyrin acetate m.p. 224-226°, $C_{32}H_{52}O_2$ have been isolated from the petroleum ether extract of the stem bark of *A. lakoocha*. β-amyrin acetate and lupeol have also been previously reported (Mahato *et al.*, 1966*b*).

**Pharmacology :** The presence of an acetylcholine-like substance in the seeds of *A. integrifolia* was demonstrated by various biological tests. Apart from the presence of acetylcholine there was evidence of the presence of another active substance which had positive inotropic and chronotropic effects on the frog's heart (Lal and Rao, 1964).

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## ARUNDO (Graminae)

*A. DONAX* Linn.

Ben. — Gahanal
Hind — Baranal
Punj. — Bansi

**Habitat:** Grows in lower Himalayas from Kashmir to Nepal, up to 1200 m from Punjab to Sylhet and the Naga Hills upto 1600-2600 m, Coorg and Nilgiri Hills.

**Parts used:** Rhizome

**Ayurvedic description**

Sanskrit : *Nala*
Synonyms : *Potagala, shoonyamadhya, dhamana*
Properties : *Rasa* — *Madhura, kashaaya, tikta*
*Guna* — *Laghu, snigdha*
*Veerya* — *Sheeta*
*Vipaaka* — *Madhura*
Actions/Uses : *Raktashodhakara, sthanya, mootrala, daahaprashamani*

**Medicinal properties and uses:** A decoction of rhizome is used as an emollient and diuretic. It is also used as a stimulant for menstrual discharge and to diminish (?) the secretion of milk (Chopra *et al.*, 1956).

**Chemistry :** From the rhizome of the plant, five indole-3-alkylamine bases, *viz.* N, N-dimethyl-tryptamine, 5-methoxy-N- methyl-tryptamine, bufotenine, dehydrobufotenine and bufotenidine were isolated. The latter two compounds have been reported for the first time from a plant species (Ghosal *et al.*, 1969).

The compounds identified and isolated from the leaves are triacontane, triacontanol, amujrin acetate, friedelin, stigmasterol, β-sitosterol and campesterol (Chaudhuri and Ghosal, 1970).

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Flower extracts of the plant yielded gramine, N, N-dimethyl tryptamine; bufotenine, 5-methoxy, N-methyl tryptamine, a new compound eleagnine, 3-3'-bisindolylmethyl dimethylammonium hydroxide, gramine methohydroxide; N, N-dimethyl tryptamine methohydroxide and uncharacterised quarternary indolic bases. This is the first time that a tetrahydro-β-carboline alkaloid (eleagnine) has been isolated from a graminaceous plant (Ghosal *et al.*, 1971).

Nine simple indole bases were isolated from the flowers. Three of these bases were reported for the first time in nature. The content of gramine decreased in flowers with the appearance and increase of the corresponding methohydroxide. This indicated that gramine methohydroxide rather than Nb-oxide, was involved in the metabolism of gramine in higher plants (Ghosal *et al.*, 1972).

**Pharmacology :** The ethanolic extract of the rhizomes produced hypotensive and antispasmodic effect against spasms induced by histamine, serotonin and acetylcholine. Bufotenidine, an alkaloid isolated from the plant, in a dose of 0·2—0·5 mg./kg. intravenously, produced a fall in blood pressure of anaesthetized dogs. The hypotensive effect could be reduced by pretreatment of the animal with d-tubocurarine. The alkaloid blocked acetylcholine-induced spasms in isolated frog rectus abdominis muscle. It was found to be a potent neuromuscular blocking agent *in vivo*, as it produced death in mice, rats and rabbits. The alkaloid had a relaxant effect on isolated loop of intestines of guineapig and dog. The drug produced spasms on isolated guineapig uterus and to a lesser extent in isolated albino rat uterus. In higher concentrations, it blocked acetylcholine-induced spasms (Ghosal *et al.*, 1969; Bhattacharya and Sanyal, 1969).

The total alkaloid fraction and some individual bases produced curare-like effects of the non-depolarising type, pronounced hypotensive response and respiratory depression. The hypotensive response was presumably histamine-release mediated. (Ghosal *et al.*, 1972).

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# ASCLEPIAS (Asclepiadaceae)

*A. CURASSAVICA* Linn.

Hind. — Kakatundi Mar. — Karki

**Habitat :** A perennial herb introduced in India from West Indies, now occurring in south India and Bengal.

**Parts used :** Leaves, roots, flowers.

**Ayurvedic description**

Sanskit : *Kaakatundi*

Properties : *Rasa* — *Tikta, kashaaya*
*Guna* — *Laghu, rooksha, teekshna*
*Veerya* — *Ushna*
*Vipaaka* — *Katu*

Actions/Uses : *Mootrala, swedakaari, jwaraghna, hridayaavasaadaka*

**Medicinal properties and uses :** Root is purgative, remedy for piles and gonorrhoea and is also used as an emetic and in the treatment of warts and cancerous growths. Juice of the leaves is anthelmintic, sudorific, used for arresting haemorrhages and gonorrhoea. Plant is used in pthisis and is poisonous (Chopra *et al.*, 1956; Nadkarni, 1954).

**Chemistry :** From the alcoholic extract of the plant, uzarigenin, calactin, colotropin, coroglaucigenin, calotropagenin and uzarin were isolated and characterised along with a new genin and its four glycosides (Singh and Rastogi, 1969).

**Pharmacology :** The alcoholic extract of the plant showed cardiotonic activity (Singh and Rastogi, 1969).

Asclepine, a new glycoside isolated from *A. curassavica*, showed typical cardiotonic effect on frog's isolated perfused heart at a dose of 2-10 mcg. Larger doses produced systolic arrest. A positive inotropic effect was observed in a dose of 5-50 mcg. in the isolated, normal and hypodynamic guineapig heart preparations. Asclepine also produced emesis in pigeons. It showed spasmogenic activity in isolated guineapig ileum and in cat intestine *in situ*. The oral absorption in cats was found to be 22·5 per cent in 5 hours, the value being similar to that of digoxin (Patnaik and Dhawan, 1971).

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## ASPARAGUS (Liliaceae)

A good deal of controversy exists on the botanical identity of the root drug *Shatawar* although this aspect has been thoroughly investigated by several workers. The drug was equated with various species of *Asparagus* viz. *A. racemosus* Willd., *A. adscendens* Roxb., and *A. sarmentosus* Linn. were considered as Shatawar (Watt, 1889). *A. gonoclados* Baker was also added to this list (Kirtikar and Basu, 1933). *A. racemosus*, *A. adscendens* and *A. gonoclados* were also regarded as *Shatawar* by Chopra (1956). The characters of the root of *A. racemosus* were compared with those of the "commercial Shatawar" and it was concluded that commercial Shatawar was not the root of *A. racemosus* (Mehra and Bhatnagar, 1958). It was found that materials collected from most places did not agree with *A. racemosus.* However, samples collected from Bordi in Thana district of Maharasthra were comparable to a great extent with *A. racemosus* except for the size of cladodes and cladode clusters (Kanitkar *et al.*, 1969).

### *A. ADSCENDENS* Roxb.

Hind., Mar. and Guj. — Sufed or Safeta, Musli, Satavar

Mal. — Shedeveli
Tam. — Tannirvittan-kizhangu
Tel. — Tsallogadda

**Habitat :** Grows in Punjab, Raiwala forests near Hardwar and Mussorie Hills.

**Parts used :** Tuberous root or rhizome decorticated.

**Medicinal properties and uses :** It is a nutritive tonic, galactogogue and demulcent. Tubers have excellent cooling and demulcent properties (Nadkarni, 1954). It is often given with boiled milk and sugar in diarrhoea and dysentery (Chopra, 1958).

### *A. RACEMOSUS* Willd.

Ben. — Satmuli
Guj. — Satavar
Hind. — Shakakul, Satavari
Kan. — Shatavari
Kash. — Sejhana
Mal. — Shatavali
Mar. — Satavari-mull
Tam. — Tannirvittan-kizhangu
Tel. — Philli-taga

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**Habitat :** Climber found all over India, specially in northern India.

**Parts used :** Roots and leaves.

**Ayurvedic description**

| | |
|---|---|
| Sanskrit : | *Shataavari* |
| Synonyms : | *Shatamooli, sheetaveerya, bahusutaa, atirasa* |
| Properties : | *Rasa* — *Madhura, tikta*<br>*Guna* — *Guru, snigdha*<br>*Veerya* — *Sheeta*<br>*Vipaaka* — *Madhura* |
| Actions/Uses : | *Balya, vrishya, vyasthapana, vranaropana, vedanasthapana, rasaayana, stanyakari* |

**Medicinal properties and uses :** Root is highly mucilaginous, antidiarrhoetic, refrigerant, diuretic, antidysentric, nutritive tonic, demulcent, galactogogue, aphrodisiac, and anti-spasmodic (Nadkarni, 1954).

**Pharmacognosy :** Histological characters of the root of *A. racemosus* have been compared with those of commercial 'Shatawar' and it has been concluded that commercial 'Shatawar' is not the root of *A. recemosus.* Commercial Shatawar shows the structure of a monocot root with a characteristic ring of sclerenchyma in the peripheral regions of the cortex (Mehra and Bhatnagar, 1958) The diagnostic characters are tabulated below :

| | *Commercial Shatawar* | *A. racemosus* |
|---|---|---|
| Piliferous layer | Absent | Present, often ruptured |
| Outer cortex | Absent | Present, 7-10 layers of suberized thick-walled cells |
| Inner cortex | 32-36 layers | 18-24 layers upper level<br>42-46 layers middle level. |
| Sclerenchyma | Present at peripheral region Sheaths of stone cells round endodermis very much reduced or absent. | Present; scattered in upper level only, absent in middle, nowhere at the peripheral region. Sheath present in upper level only. Reduced or absent in the middle. |
| Stone cells | D60—120μ<br>L225-420-975μ | D20—30μ, L180-330-480μ |

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| | *Commercial Shatawar* | *A. racemosus* |
|---|---|---|
| Raphides | 30-45μ | 45-60μ |
| Vascular bundles | 50-60 | 30-35 in upper level<br>35-45 in the middle |
| Tracheids | D4-8μ, L515-915-1500μ | D5-20μ, L1125-1600-1950μ |
| Metaxylem vassel | D48-130μ, L600-900-1265μ | D50-130μ, L1650-1800-2175μ |
| Fibrous pith cells | D15-30-45μ<br>L450-915-1425μ | D16-32-58μ<br>L450-675-1245μ |

Structure of the peeled-off tissues of the roots which yielded 'Shatawar' has been reported. Transverse section of the peeled off tissue of the commercial drug shows the following characteres : Beneath outermost piliferous layer, 6-8 layers of compactly arranged cells are present. There is great variation in the size of these axially arranged cells, which otherwise have the same general characters as in *A. racemosus*. Below are found a few layers of smaller parenchymatous cells with minute pittings on their walls, followed by a ring of sclerenchyma. Roots of *A. adscendens*, *A. curillus*, *A. gracilis* and *A. sprengeri* were properly identified and studied.

*A. adscendens*—Root 30-100 cm. long, 0·7-1 cm. thick, scars and protuberances of the lateral rootlets seen all over external surface, hard, odourless and sweetish in taste. A transection of the root shows an outer cortex with similar characters like *A. racemosus*. Sclerenchyma is present in the inner cortex. Pith is completely or partially lignified. Vascular bundles 34-37 at upper end and 45-50 at the middle level.

*A. curillus* —Root shorter in length than *A. adscendens*, 37-64 cm. and light brown in colour. In transection it resembles *A. adscendens*. The number of vascular bundles here are fewer, 20-25 at upper and 33-38 at middle level.

*A. gracilis*—Roots non-tuberous, thin, cylindrical, 17-45 cm. long and 0·2-0·6 cm. thick, brown to dark brown, with wrinkles all over.

Structure of the non-tuberous root is the same throughout the length; sclerenchyma completely absent in the inner cortex. Vascular bundles are 20-24. Pith is fibrous with a few septate cells. The distribution of sclerenchyma in a dispersed fashion in the inner cortex of the first two species is different from market sample. Unlike 'Shatawar' all the species investigated possessed a well developed sclerenchymatous sheath surrounding the endodermis.

*A. sprengeri*—Main roots 50 cm or more in length, 0·1-0·3 cm. in thickness, dark brown in colour. Terminal portion of some of the main roots and most lateral rootlets become swollen and tuberous at places. Tuberous fusiform portions are 2·5-4 cm. long and 1·5 cm. thick; initially sweetish but later bitter in taste.

Microscopically, in the main root, piliferous layer is often ruptured, cells small, thin walled, some outermost cells modified into root hairs. Sclerenchyma absent

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in the cortex of the non-tuberous main root. Sheath of stone cells present in main root but absent in rootlet. Vascular bundles 30-36 in main root, 19-21 in rootlet. Pith mostly fibrous in main root but peripheral cells sclerized and slightly thickened in rootlet. It was therefore concluded that none of these four species can be the source of commercial Shatawar (Mehra and Bhatnagar, 1968).

Pharmacognostic studies were carried out on a hitherto unrecorded form of *A. racemosus* distributed along the Western coast in Palghar-Dahanu-Bordi area of Thana district. The form differed from typical *A. racemosus* in the number of cladodes in cluster, size of individual cladodes, spines, inflorescence and flowers. The time of flowering of this form was also different.

Microscopic studies revealed differences in root anatomy, *e.g.* average size and range of vessels, size of the large metaxylem vessels, size of the cells of inner cortex and relative development of pith. Microchemical and fluorescence tests were done (Kanitkar *et al.*, 1969*a*).

Further, the macroscopic, microscopic and chemical studies showed that there is difference in the Shatawar material from the south and the north indicating possibility of two different botanical sources of Shatawar in India (Kanitkar *et al.*, 1969*b*).

Thirteen authenticated samples of *A. racemosus* collected from all over India were examined. These samples however did not satisfy the characters of cladode length and cladode clusters specified for *A. racemosus*. It has been felt, therefore, that a remodelling of the key for the botanical identification by use of more constant characters is necessary. Characters like the form of cladodes and the shape of the leaves might be considered of some taxonomic importance in *Asparagus* (Kanitkar, 1970).

**Chemistry** : The powdered dried root of *A. racemosus* was extracted with different solvents. Of these, the alcohol, ethyl acetate and acetone extracts yielded a number of pharmacologically active (anti-oxytocic) saponins. A study of various samples of the plant obtained from different places revealed that saponin $A_4$ was the major component in the samples from Poona market, Thana, Simhagad and Madras, whereas saponins $A_5$ and $A_6$ were predominant in the samples from Malad and Bordi. Saponin $A_4$ was obtained as an amorphous, white powder, m.p. 191-5° which, on acid hydrolysis, yielded sarsasapogenin, glucose and rhamnose. Saponin $A_7$ was obtained after repeated crystallisation from methanol as colourless plates, m.p. 207-9° and analysed for $C_{45}H_{74}O_{17}$. The molecular formula of saponin $A_7$ agreed with the presence of two glucose and one rhamnose unit linked to sarsasapogenin. Glycoside $A_8$ was obtained as needles from methanol, m.p. 152-154·5° (Sukhdev, 1970).

**Pharmacology** : The aqueous solution of the crude alcoholic extract of the roots of *A. racemosus* in a dose of 10-20 mg. caused initial increase in force and rate of contraction in isolated frog's heart but a higher dose (40 mg.) caused cardiac arrest. The glycosidal fraction (0·5 mg.) of the plant produced bradycardia and reduction in the

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force of contraction but with 1-5 mg. dose, complete cardiac arrest was observed for some time after which the force of contraction was restored to normal. A high dose *i.e.* 15 mg./kg. of crude alcoholic extract produced a fall in blood pressure and depression in the respiration of cat. The hypotensive effect could be antagonised by pretreatment with atropine but not with anti-histaminics. In mice and rats, mesentric capillary circulation became static with topical and intravenous administration of the crude alcoholic extract. The extract also caused an increase in bleeding time in the rabbit and slight diuretic effect in the rat (Roy *et al.*, 1968, 1971).

The alcoholic extract of the roots of the plant exhibited anti-oxytocic activity. It was found to contain several saponins. The saponin-glycoside ($A_4$) in doses of 20-500 mcg./ml. produced a specific and competitive block of the pitocin (syntocinon)—induced contraction of rat, guineapig and rabbit uteri *in vitro* as well as *in situ*. The saponin also blocked the spontaneous uterine motility. It was also found that the hypotensive action of syntocinon in cat was unaffected by previous administration of saponin $A_4$ (Gaitonde and Jetmalani, 1969*a*, 1969*b*, 1970).

The crude alcoholic extract of the roots increased the weight of mammary glands in post-partum and estrogen-primed rats and the uterine weight in estrogen-primed group. The increase in the weight of adrenals coupled with the depletion of ascorbic acid suggested the release of pituitary ACTH. Estrogen-primed rats receiving the extract showed well developed lobuloalveolar tissue with milk secretion. The mechanism of action of the extract may be through a direct action on the mammary gland or through the pituitary or pituitary-adrenal axis due to the secretion of prolactin and ACTH (Sabnis *et al.*, 1958; Jetmalani *et al.*, 1967).

In a veterinary study, the roots of *A. racemosus* have been found to have galactogogue action in buffaloes in which the milk yield was found to be significantly increased after the use of the drug (Patel and Kanitkar, 1969).

The alcoholic extract of the aerial parts of *A. racemosus* showed anti-cancer activity in human epidermal carcinoma of the nasopharynx in tissue culture (Dhar *et al.*, 1968).

The aqueous solution of the crude alcoholic extract of the roots of *A. racemosus* also had an inhibitory effect on the growth of *E. histolytica in vitro* (Roy *et al.*, 1968, 1971). In another study, the alcoholic extract of the whole plant *A. filicinus* showed anti-protozoal activity against *E. histolytica* (Dhar *et al.*, 1968).

The aqueous extracts of both fresh and dried roots were found to have amylase and lipase activities, the activity being higher in the former. The optimum pH at which these activities could be found were 4 to 5 for α-amylase, 6·9 for β-amylase for the amylase activity and 7·4 for lipase activity (Dange *et al.*, 1969).

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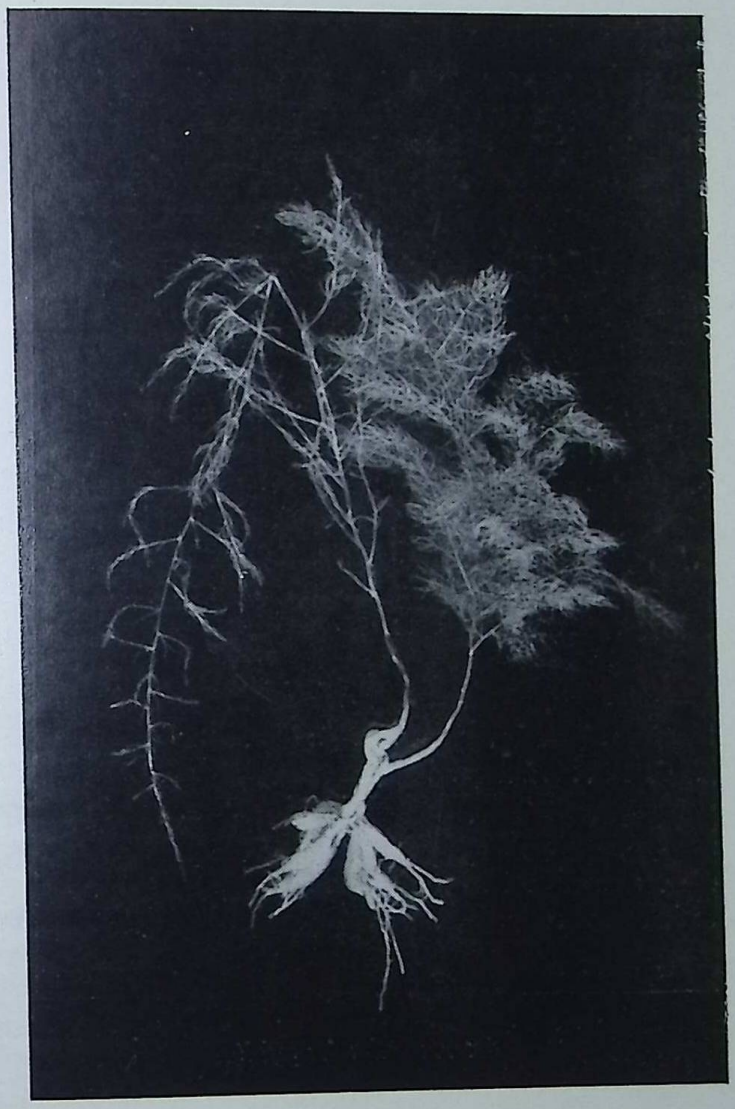

*Asparagus racemosus*

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*Asteracantha longifolia*

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# ASTERACANTHA (Acanthaceae)

*A. LONGIFOLIA* Nees (Syn. *Hygrophila auriculata* (Schumach)Heime).

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Kantakalika | Mar. | — | Kolsundara |
| Guj. | — | Ekharo, Gokhru | Mal. | — | Yayalculli |
| Hind. | — | Gokhula-kanta, Gokhura | Punj. and Kash. | — | Talmakhana |
| Kan. | — | Kolavalike | Tam. | — | Nirmulli |
| | | | Tel. | — | Neerugobbi |

**Habitat :** Common in moist places, on the banks of tanks, ditches, paddy fields throughout India.

**Parts used :** Whole plant, seeds, roots, leaves and ashes of the plant.

**Ayurvedic description**

Sanskrit : *Kokilaaksha*

Synonym : *Ikshuraka*

Properties : *Rasa* — *Madhura, tikta*
*Guna* — *Snigdha*
*Veerya* — *Sheeta*
*Vipaaka* — *Madhura*

Actions/Uses : *Shothahara, mootrala, balya, brihmana, vrishya, anulomana; vaatarakta, netraroga.*

**Medicinal properties and uses :** Root is cooling, bitter tonic, diuretic, demulcent and refrigerant. Seeds are diuretic while leaves are demulcent and diuretic, ashes and decoction of root are diuretic (Nadkarni, 1954).

The whole herb, root and seeds are used as a diuretic in the treatment of dropsy and also in jaundice, rheumatism, anasarca, dysentery and diseases of the urinogenital tract. Leaves are used for cough and applied externally in gout, lumbago, pain in joints *etc.* (Mehrotra and Kundu, 1962).

**Pharmacognosy :** The macroscopic and microscopic characters of the stem and leaf of *A. longifolia* have been described. The stem is characterised by opposite, lanceolate leaves and six straight or slightly curved thorns at the nodes. Two kinds of trichomes, uniseriate, 1-5 celled, non-glandular trichomes and glandular trichomes with a stalk and eight head cells are present. Although there is no regular extrastellar secondary growth, many lenticels are formed sporadically.

The epidermis becomes two layered at some places by periclinal divisions, some collenchyma of hypodermal region develops lignified secondary walls with slit-shaped

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pits. The inner layer of cortex forms a regular endodermis with casparian band on radial walls of the cells, containing starch grains. The primary phloem fibres along with the intervening parenchyma cells form a layer of pericycle. These fibres are much longer than the secondary fibres formed later. Some wood fibres in the secondary wood are septate. The stomata are mainly caryophyllaceous and are present on both surfaces. Cystoliths are present in large number in epidermis of stem and leaf. Palisade ratio, stomatal index and vein-islet number have also been determined. The microscopic character of the powdered drug are as follows : light green in colour, fragments of epidermis of stem and leaf with or without cystoliths, free cystoliths, broken non-glandular hairs, oil globules free and in parenchyma cells, calcium oxalate crystals, broken and complete vessels, pieces of fibres complete or broken and xylem parenchyma cells are observed (Mehrotra and Kundu, 1962).

**Chemistry :** The acetone, alcohol and water extracts of the aerial parts showed the presence of alkaloids. An alkaloidal fraction was obtained with alcohol by percolation method with subsequent acidification and extraction with chloroform. The essential oil was obtained by steam distillation. The oil of roots was light reddish brown whereas the oil of aerial parts was pale yellow (Parashar and Singh, 1965*a*).

The unsaponifiable fraction of the oil from the seeds, yielded one sterol-like compound which was provisionally given the molecular formula $C_{31}H_{54}O_2$. This was probably a new sterol as the m.p. and m.m.p. of the derivatives and the molecula formula did not tally with the other four sterols previously isolated (Parashar and Singh, 1965*b*).

**Pharmacology :** A 1 per cent wt./vol. aqueous solution of the hydrochloride of the alkaloid showed a slight relaxant action on isolated duodenum of rat. It inhibited the stimulant action of acetylcholine on the isolated strip of duodenum. The stimulatory action of acetylcholine on isolated uterus of rat was inhibited by the alkaloidal solution. It increased the rate and amplitude of contraction of the pithed frog heart and improved the tone of cardiac muscle. An increase in the amplitude of contraction of ventricle and auricle and slight increase in the heart rate was observed in anaesthetized dog. However, the blood pressure of the anaesthetized dog was lowered even after vagotomy or after atropinisation. The rate and depth of respiration of anaesthetized dog and rabbit were found to be increased by the alkaloidal solution. The solution also produced strychnine-like convulsions in frogs. The alkaloidal solution showed diuretic activity in anaesthetized rabbits. The essential oils showed antibacterial action against gram positive and gram negative organisms (Parashar and Singh, 1965*a*).

The alcoholic extract of the whole plant inhibited the growth of pathogenic fungi *in vitro viz. Trichophyton mentagrophytes*, *Trichophyton rubrum*, *Microsporum gypseum*, *Epidermophyton floccosum* and *Candida albicans* (Venkitaraman and Radhakrishnan, 1972).

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# ATALANTIA (Rutaceae)

*A. MONOPHYLLA* Correa

| | | | | | |
|---|---|---|---|---|---|
| Eng. | — | Wild lime | Mar. | — | Makadlimbu |
| Guj. | — | Dodi-nimbu | Sans. | — | Atavi-jambeera |
| Kan. | — | Kaadu-limbe | Tam. | — | Kattuelumiccampazham |
| Mal. | — | Malenarakam | Tel. | — | Adavi-nimma |

**Habitat :** Found in east Bengal and south India.

**Parts used :** Roots, berries and leaves.

**Medicinal properties uses :** Berries are used in fever. Root is regarded as antiseptic and stimulant and leaves are used in snake bite (Nadkarni, 1954).

**Chemistry :** Atalantin, $C_{27}H_{32}O_9$, a tetra-nor-triterpenoid was isolated from the root bark. Its NMR spectrum revealed similarity with limonoids having a furanolactone system. The presence of β-substituted furan ring in its NMR was confirmed by the isolation of furan-3-aldehyde by treatment with methanolic alkali. Hydrolysis of atalantin with dilute alkali followed by esterification with diazomethane furnished four crystalline products *viz.* (*i*) atalantin (*ii*) a compound containing an α-diketone system (*iii*) an enol giving the same acetate as from (*ii*) above, and (*iv*) isoatalantin, an isomer of atalantin. On the basis of spectral and chemical evidence, a tentative structure was proposed for atalantin (Thakar and Sabata, 1967).

Two new acridone alkaloids were isolated from the root bark collected from Madras *viz.* atalaphylline and N—methylatalaphylline. Atalaphylline, m.p. 246°, $C_{23}H_{25}NO_4$ showed ultraviolet and infrared absorption spectra characteristic of

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9-acridones. The minor alkaloid N-methyl-atalaphylline had m.p. 192-193°, molecular formula $C_{24}H_{27}NO_4$, ultraviolet and infrared spectra similar to the first one (Govindachari *et al.*, 1970).

From the petroleum ether extract of the roots, a new alkaloid N-methylbicycloatala phylline, was isolated along with other constituents. The alkaloid has the molecular formula $C_{24}H_{27}NO_4$, m.p. 185° (Basu and Basa, 1972).

**Pharmacology :** The alcoholic extract of the aerial parts of *A. racemosa* was found to have antiviral activity against *Ranikhet disease virus* (Bhakuni *et al.*, 1971).

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## ATROPA (Solanaceae)

*A. ACUMINATA* Royle ex Londley

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Yebruj | Kash. | — | Mait-brand |
| Eng. | — | Indian Belladonna | Mar. | — | Girbuti |
| Hind. | — | Sag-angur | Punj. | — | Bantamaku |

**Habitat :** Grows wild in Kashmir Himalayas at 2,000-4,000 m.

**Parts used :** Roots, leaves and berries.

**Medicinal properties and uses :** Roots and leaves are narcotic, sedative, diuretic, mydriatic and used as an anodyne. Berries are poisonous (Chopra *et al.*, 1956; Nadkarni, 1954).

*A. BELLADONNA* Linn.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Yebruj | Hind. | — | Sag-angur, Angurshefa |
| Eng. | — | Deadly Nightshade | Mar. | — | Girbuti |

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*Atropa acuminata*

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*Azadirachta indica*

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**Habitat :** In Himalayan ranges extending from Simla to Kashmir, found wild in Kunawar.

**Parts used :** Roots and leaves.

**Medicinal properties and uses :** Belladonna has been regarded as a powerful drug. Alkaloid atropine is used as a sedative, antispasmodic, anodyne and mydriatic in diseases of the eye (Chopra *et al.*, 1956; Nadkarni, 1954).

**Pharmacognosy :** On the basis of the following characters the leaves of *A. acuminata* have been idedtified from other Solanaceous leaves:

Vein-terminal number—6-8-9, vein-islets number—5-6-8, palisade ratio—5-6.2-8. Few cells with microcrystals of calcium oxalate were found widely scattered (Singh, 1967).

**Chemistry :** A simple method for the estimation of atropine in pharmaceutical preparations based on the linear relationship between the concentration of atropine and colour intesity of its chloroform-soluble complex formed with bromocresol green solution at pH 5·6 has been described. The method could be applicable in the concentration range of 20-120 mcg. of atropine (Srivastava *et al.*, 1963).

**Pharmacology :** The alcoholic extract of the leaves of *A. belladonna* was found to have hypoglycaemic activity in albino rats. The extract also showed anti-protozoal activity against *Entamoeba histolytica* and anti-viral activity against *Ranikhet disease virus* (Dhar *et al.*, 1968).

The studies on the effect of atropine alone and in combination with various tranquillizers, revealed that the reaction time in mice to morphine-induced analgesia which were pretreated with chlorpromazine or thioridazine and atropine together was definitely longer than in those which were pretreated with chlorpromazine or thioridazine alone. The reaction time of mice to morphine-induced analgesia was reduced by pretreatment with atropine sulphate (Prasad and Kar, 1966).

The effects of three belladona alkaloids *viz.* atropine, scopolamine and homatropine were studied in different doses on the spontaneous and enhanced vestibular neuronal activity of anaesthetized cats. Lower doses of atropine (10 mcg/kg.) and scopolamine (2 mcg./kg.) were found ineffective. A dose of 50-100 mcg./kg. of atropine and 5-10 mcg./kg. of scopolamine decreased the spontaneous and acceleration modulated firing of the neurones. Homatropine was found relatively ineffective even in a dose of 2·0 mg./kg. (Jaju *et al.*, 1970).

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## AZADIRACHTA (Meliaceae)

*A. INDICA* A. Juss (Syn. *Melia azadirachta* Linn).

| | | | | | |
|---|---|---|---|---|---|
| Eng. | — | Neem, Margosa tree | Mal | — | Veppu |
| Guj. | — | Limba | Mar. | — | Kadunimba |
| Hind., Punj. | | | Tam. | — | Vembu, Veppamaram |
| and Ben. | — | Nim or Nimb | Tel. | — | Vepa |
| Kan. | — | Bevinamara | | | |
| Kon. | — | Beva-rooku | | | |

**Habitat :** A large ever-green glabrous tree found all over India, also cultivated.

**Parts used :** Whole plant, bark, root-bark, young fruits, nut or seed, flowers, leaves, gum and toddy.

**Ayurvedic description**

Sanskrit : *Nimba*

Synonyms : *Pichumarda, pichchumanda, tiktaka, arishta, paaribhadra*

Properties :

| | | |
|---|---|---|
| *Rasa* | — | *Tikta, kashaaya* |
| *Guna* | — | *Laghu* |
| *Veerya* | — | *Sheeta* |
| *Vipaaka* | — | *Katu* |

Actions/Uses : *Raktashodhaka, kanduughna, kushtaghna, vamana, vranashodhana, daahaprashamana, graahi, hridya, krimighna, netrya, kaamalaghna.*

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**Medicinal properties and uses :** Used in leprosy, intestinal worms, piles and urinary diseases. Root-bark and young fruit are astringent, tonic and antiperiodic. Bark is bitter, tonic, astringent, antiperiodic and also vermifuge. Fruit is purgative, emollient and anthelmintic. Leaves are discutient, leaf juice anthelmintic. Oil from nuts and leaves act as local stimulant, insecticide and antiseptic. Flowers are stimulant, tonic, and stomachic. Gum from the bark is stimulant and demulcent tonic. The drug also possesses antispirochaetal and emmenagogue properties (Nadkarni, 1954).

**Pharmacognosy :** A tall, evergreen, glabrous tree with greyish or brownish bark and delicate foliage. Leaves are imparipinnate, 20-37·5 cm. long, crowded near the end of branches. Leaflets 14-19, opposite or alternate, flowers are in short axilliary panicles, white scented. Drupe 1·2-1·8 cm. long, oblong.

Bark is channelled, tough, fibrous, brownish grey with a rough scaly surface. Internally bark is yellowish, laminated, and coarsely fibrous. The smooth transverse surface is found to be minutely chequered, pale, narrow medullary rays and tangential bands of parenchyma alternate with drak groups of bast fibres. The bast fibres appear to be surrounded by lignified parenchyma cells (Bhandari and Mukerji, 1959).

The structure of the neem fruit and seed has also been described. Fruit when fresh is found to be greenish yellow in colour and after drying becomes darker. It shows a scanty pulp and bony endocarp. Seeds are dirty brown, 1 cm. in length, 4-5 mm. in width, hilum not well marked, taste bitter, odour characteristic, raphe present.

After the removal of seed coat, a cellular structure is seen with thick walled irregularly rounded or polygonal cells, brown in colour, with crystals of calcium oxalate. The cotyledons are straight and non-endospermic. The powder of the seed is dirty brown in colour, bitter in taste with gritty touch and oily (Harave—Personal communication).

**Chemistry :** The petroleum ether extract of the dry flowers gave a waxy substance which yielded β-sitosterol. The flavonoids of neem flowers consist of three related compounds, kaempferol, quarcetin and myricetin. The first is 0·2 per cent of air dried flowers and the other two make up another 0·2 per cent. They were present mostly as glycosides extractable with hot alcohol. The following compounds were also obtained from dry flowers : (*i*) a green, amorphous, bitter toxic substance, (*ii*) nonacosane $C_{29}H_{60}$, m.p. 64-6°, (*iii*) a highly pungent essential oil, and (*iv*) a sesquiterpene and a fatty acid fraction (Pankajmani and Seshadri 1952).

The trunk bark contained nimbin (0·04 per cent), nimbinin (0·001 per cent), nimbidin (0·4 per cent), nimbosterol (0·03 per cent), essential oil (0·02 per cent), tannin (6·0 per cent) and a bitter principle, margosine. Neem oil contained various acids, sulphur, etc. (Bhandari and Mukerji, 1959).

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Preliminary chemical examination of the oil indicated the presence of sulphur (0·427 per cent). The principal constituents of the oil were sulphur, a very bitter yellowish substance which was suspected to be an alkaloid, resins, glycosides and fatty acids. The bitter principles of the oil and oil cake could be extracted with alcohol. After removing the sparingly soluble fatty acids, the bitter principles could be divided into (*i*) benzene scluble and (*ii*) alcohol soluble components. They were free of sulphur and contained oxygen, had empirical formula $C_5H_7O_2$ and $C_4H_2O_2$ and were non-toxic (Murti *et al.*, 1940).

Earlier workers had claimed to have obtained new acids from the oil. This has been proved to be incorrect. The oil was found to contain normal acids of fatty oil (Rao and Seshadri, 1942).

Hot aqueous extract of crushed neem seeds on removal of the albuminous and other foreign matter by basic lead acetate, yielded a white non-bitter sulphur containing product, $C_{13}\ H_{27}O_7S_2$ which was laevorotatory.

The petroleum ether extract of all the flowers yielded a water-insoluble amorphous bitter of acidic character. The petroleum ether soluble fraction yielded nimbosterol (β-sitosterol), m.p. 137°. It appeared that the well formed bitter constituents of the plant were not present as such in the leaves, but the precursors of the active principles were predominantly present in them. Nimbosterol could be obtained from other plant parts as well.

The structure of the gum has been investigated. It was obtained as a non-reducing white powder after purification by precipitation with alcohol. On hydrolysis, the gum yielded L-arabinose, L-fucose, D-galactose and D-glucoronic acid. The aldobiuronic acid component of the gum was shown to be 4-0-(D-glucopyranosyl uronic acid)-D-galactopyranose.

The presence of free amino acids in the stem exudate was of considerable importance. The heartwood showed the presence of tannins, inorganic calcium, potassium and iron salts in the alcohol and acetone extracts. The extracts yielded an ether-soluble crystalline compound $C_{24}H_{30}O_5$ m.p. 137-138° provisionally called 'nimatone' on which IR and UV studies were also conducted. Chemical structure of the active principles of neem has also been reported (Mitra, 1963).

Desacetylnimbin has been isolated from the seeds and bark of *A. indica* as a natural product (Narayanan and Iyer, 1967).

The isolation of quercetin and β-sitosterol from the leaves of *A. indica* has also been reported (Barak and Chakraborty, 1968).

**Pharmacology** : The leaf extract yielded fractions which markedly delayed clotting time. Action of extract on plasma clotting time using Russel's Viper venom was

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studied and the most effective inhibition of clotting with the extract was obtained at full saturation of ammonium sulphate (Bhat and Broker, 1954). Insecticidal and insect-repellant properties of neem have been reported (Bhasin 1927, Krishnamurthi and Rao, 1950).

Neem oil inhibited the growth of all the three strains of *M. tuberculosis* and *M. pyogenes* var. *aureus* in a concentration of 12·5 mcg./ml. The growth of *S. typhosa*, *S. paratyphi* and *Vibrio cholerae inaba* was inhibited in a concentration of 200 mcg./ml. and that of *Klebsiella pneumoniae* in a concentration of 500 mcg./ml. (Chopra *et al.*, 1958).

A 10 per cent water extract of the leaves of the plant was found to possess antiviral properties. The extract was found non-toxic both to chick embryonic tissue culture and chorio-allantoic membrane. It inhibited plaque formation of vaccinia virus in tissue culture. Antiviral effects of the extract were also observed on the skin of rabbits and monkeys (Rao *et al.*, 1969).

Neem oil and two of its bitter principles nimbidin and nimbidol were studied for their antibacterial effects. Nimbidin inhibited the growth of the fungus *Tinea rubrum*. It also inhibited *M. tuberculosis* $H_{37}$ $R_V$, in a concentration of 1/1000 in 3 weeks *in vitro*. Neem oil and nimbidol in higher concentrations exhibited partial inhibitory influence. The *in vivo* studies revealed that nimbidin prolonged the survival period in mice infected with tuberculosis. Neem oil depressed the hypersensitivity to tuberculin in sensitized guineapigs (Murthy and Sirsi, 1957).

The seeds of the plant were found to contain about 30 per cent of oil which was bitter in taste. A series of compounds were isolated from the oil in crystalline form. One of the components was nimbidinic acid, the sodium salt of which was found to be an active compound. Sodium nimbidinate in a concentration of $10^{-6}$ gm./ml. for 30 seconds lowered the tone of isolated intestinal strips of rabbit and frog without affecting the spontaneous activity. A higher concentration also relaxed the intestinal tone. An intravenous dose of 10 mg./kg. of sodium nimbidinate, caused relaxation of non-pregnant cat's uterus *in situ*. The drug produced a fall in the blood pressure of anaesthetized cat in higher doses (20-40 mg./kg.). The fall of blood pressure was unaffected by pretreatment with atropine. An increase in the amplitude and slight irregularity in the rhythm of respiration was also observed (Gaitonde and Sheth, 1958).

Nimbidin and sodium nimbidinate caused slowing of heart rate in frogs followed by missing of beats, partial heart block and finally cardiac arrest in diastole by directly depressing the cardiac muscle.

Nimbidin and sodium nimbidinate killed *Paramaecium caudatum* in 1/500 dilution in 1 minute. The action of sodium nimbidinate was found to be more potent than nimbidin (Bhatia, 1943). Nimbidin caused initial stimulation followed by depression of nervous system.

Sodium nimbidinate was found to be a potent diuretic agent in dogs. It was found that 20 mg. of sodium nimbidinate was more potent than 12 gms. of urea. The

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drug acted primarily upon the renal tubules, retarded the excretion of phenol-sulphonephthalein and reabsorbed electrolytes and water. A higher dose given orally was also found to be effective (Bhide *et al.*, 1958*a*).

Clinical trials were conducted on 9 patients of congestive cardiac failure with anasarca to study the diuretic effect of sodium nimbidinate. 250 mg. were administered daily by deep intra-muscular injection in the gluteal region. The injections were repeated for 2-13 days with an average of about 5 injections per patient. Four other patients were also studied as controls on the same lines with bed rest, low sodium diet and adequate digitalization without any diuretic. Eight of the patients showed a definite diuretic response. The control group did not show any diuresis. No toxic reaction was noted except local discomfort or slight pain (Shah *et al.*, 1958). In another study, clinical trials were conducted on 12 cases of congestive cardiac failure with sodium nimbidinate for diuretic activity. Encouraging diuretic activity was observed with good response in 8 cases and moderate response in 4 cases. There was no significant toxicity (Shah *et al.*, 1959).

A spermicidal activity was also noted in sodium nimbidinate. 2·5 mg. per cent of sodium nimbidinate killed all the rat sperms in 30 minutes *in vitro*. However, a higher dose i.e. 50 mg. per cent, killed these sperms in 5 minutes only. The lethal concentration for human sperms was found to be 1000 mg. per cent and 250 mg. per cent in 5 and 30 minutes respectively (Sharma and Saksena, 1959*a*). Another related compound sodium nimbinate was also found to have powerful spermicidal action in rats up to 1 : 2000 dilution (Sharma and Saksena, 1959*b*).

Sodium nimbidinate was a relatively non-irritating substance. $LD_{50}$ by intraperitoneal route in mice was found to be 700 mg./kg. The dogs tolerated up to 200 mg./kg. by oral, intramuscular and intravenous routes. With a large single dose e.g. 100 mg./kg., proliferation of endothelial cells in glomerular apparatus was observed. The renal tubules revealed cloudy swelling, fatty infiltration and necrosis in the convoluted segment (Bhide *et al.*, 1958*b*).

Nimbidol in a dose of 50 mg./kg. in rats, caused immediate reduction in temperature equivalent to that of acetanilide, the effect being more lasting than that of the latter (Murthy and Sirsi, 1958*a*). Nimbidol was also found to be more potent than nimbidin at a dose of 25 mg./100 gm. body weight given orally twice a day for 4 days in suppressing the infection of *Plasmodium gellinaecum* in chicks (Murthy and Sirsi, 1958*b*).

Nimbidin was found to be effective in various skin diseases such as furunculosis, arsenical dermatitis, ulcers due to burns, *Herpes labialis* infection, scabies and seborrhoeic dermatitis. Nimbidin gargle and dentifrices have been found to be effective in the treatment of bleeding gums, pyorrhoea *etc.* (Bose 1943).

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## BACCAUREA (Euphorbiaceae)

*B. SAPIDA* Mvell Arg.

Ben. — Latqua

**Habitat :** Occurs wild and also cultivated in Sub-Himalayan tracts, Assam, Burma and in Andamans. It prefers a deep moist soil and wet climate.

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**Chemistry*** : The benzene extract of the bark was separated into ether soluble and ether insoluble portions. From the latter after acetylation, chromatography and crystallisation from acetone, a solid with m.p. 162-164° was obtained. The ether soluble part was separated into acidic and neutral fractions. The acidic fraction on esterification with diazomethane and subsequent chromatography of the crude ester, yielded two compounds, one with m.p. 138-139° and the second with m.p. 220-222°, identified as methyl betulinate. The compounds isolated from neutral ether solution were friedelin, m.p. 256-258°, $C_{30}H_{50}O$; epi-friedelanol, m.p. 274-276°, $C_{30}H_{52}O$; its acetate m.p. 290-292° and β-sitosterol, m.p. 135-136°, $C_{29}H_{50}O$ (Misra and Khastgir, 1967).

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## BACOPA (Scrophulariaceae)

*B. MONNIERA* Linn. (Syn. *Herpestis monniera* (Linn.) H.B. & K.)

Ben. — Brihim-sak
Hind. — Brahmi
Mal. and Tam. — Nirbrahmi

**Habitat :** Annual creeping plant found throughout India in wet, damp and marshy areas.

**Parts used :** Stem and leaves.

**Ayurvedic description**

Sanskrit : *Braahmi*

Synonyms : *Jalanimba, laghubraahmi, jalajabraahmi*

Properties :
*Rasa* — *Tikta, kashaaya*
*Guna* — *Laghu, snigdha, sara*
*Veerya* — *Sheeta*
*Vipaaka* — *Madhura*

*No report available on other aspects.

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Actions/Uses : *Deepana, paachana, rasaayani, swarya, aayushkara, medhya, kushta-kandoohara, jwaraghna, vishaghna, apasmaarahara, vedanasthapana, mehaghna, shothahara.*

**Medicinal properties and uses :** The plant is a nervine tonic, used in asthma, epilepsy and insanity. It is also used as diuretic and aperient. Stem and leaves are used in snake-bite (Chopra *et al.*, 1956; Nadkarni, 1954).

**Pharmacognosy :** *B. floribunda* is an erect herb with obtusely four-angled stem which is often branched. Leaves are subsessile and opposite. Flowers are in the axil of every leaf. Various types of trichomes occur on different parts and the epidermal features of the species are found to be of some taxonomic importance. The various types of uniseriate trichomes are vesicular peltate hair, conical hair and capitate hair. Similarly, the epidermal features like the stomata and epidermal cells are also of taxonomic significance (Rajgopal and Ramayya, 1970).

**Chemistry :** The isolation of the alkaloids, brahmine and herpestine and a mixture of three alkaloids from the leaves of *B. monniera* was previously reported (Bose and Bose, 1931; Basu and Pabrai, 1947). Later, D-mannitol and a saponin with m.p. 232-4° (decomp.) were also reported to be present (Sastry *et al.*, 1959). From the extract of the whole plant, betulic acid, a crystalline saponin and a crystalline product with m.p. 71° were isolated. This saponin on hydrolysis gave glucose, arabinose and an aglycone (Rastogi and Dhar, 1960).

The saponins designated as bacoside A (m.p. 251-1° decomp.) and bacoside B (m.p. 203° decomp.), betulic acid, D-mannitol, stigmastanol, β-sitosterol and stigmasterol were isolated from the whole plant. Bacoside A was obtained in free state whereas bacoside B could only be isolated as mixed crystals with bacoside A. The mixed crystals (m.p. 275° decomp.) were resolved into two saponins by partition chromatography over silica gel. Bacoside A, on acid hydrolysis gave three sugars, two of which have been identified as glucose and arabinose. Bacoside B also gave on hydrolysis glucose and arabinose (Chatterji *et al.*, 1963; Banerjee and Chakravarti, 1963).

The carbohydrate moiety of bacoside A was shown to be arabinosyl-glucose, with the arabinose unit as the terminal sugar. Four crystalline compounds were obtained from the aglycone mixture obtained from the hydrolysis of bacoside A. On the basis of physical and chemical studies with bacogenin A, which was the most polar component obtained during the acid hydrolysis, the structure of bacoside A has been elucidated (Chatterji *et al.*, 1965).

Bacoside B, on hydrolysis, gave glucose, arbinose, and bacogenins, $A_1$, $A_2$, $A_3$ and $A_4$. Thus the same gross structure as bacoside A was proposed for bacoside B also. However, bacoside B was found to be dextro-rotatory whereas bacoside A was laevo-rotatory. The haemolytic action of bacoside B was twice that of bacoside A, due to the differences in the configuration of the carbohydrate parts (Basu *et al.*, 1967)

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**Pharmacology :** The crude alcoholic extract of *B. monniera* had a sedative effect on frogs and dogs in a dose of 10-200 mg./100 gm. body weight. The extract was also found to have cardiotonic, vasoconstrictor and neuro-muscular blocking actions in frogs. A glycoside (saponin) fraction isolated in pure form was also found to have cardiotonic action in normal as well as hypodynamic frog's heart. A sedative action in rats and guineapigs was also observed. A spasmodic action was seen on rabbits and guineapig's ileum (1 : 20,000 to 1 : 10,000) and rat's uterus (1 : 10,000) with the glycoside (saponin) fraction (Malhotra and Das, 1959).

The alcoholic extract of the whole plant, in a dose of 50 mg./kg. given intraperitoneally, exhibited tranquillizing effect on albino rats. The same effect was observed in dogs, when the above dose was given intravenously. The extract relaxed the smooth muscles of rat ileum. The aqueous extract also exhibited the same effect though to a lesser degree. The extract also reduced the histamine-induced contraction (3·0 mcg./ml.) of the guineapig tracheal chain by 75 per cent at 3·5 mg./ml. The extract at doses of 5 mg./kg. and 10 mg./kg. had virtually no effect on the blood pressure, but a diminution of the respiratory amplitude and a slight relaxation and lessened motility of the intestine were noticed. At 20 mg./kg., a transitory fall in blood pressure was seen (Aithal and Sirsi, 1961).

The total alkaloidal fraction, in a dose of 0·2 to 2·0 mg./kg. given intravenously, produced an initial fall followed by a rise in the blood pressure of dogs. An initial stimulation of respiration was followed by slight depression. Tachyphylaxis was observed with repeated administration of the drug at intervals of 2-5 minutes. The negative chronotropic effect and initial hypotensive response was blocked by atropine sulphate (1 mg./kg. i.v.). Administration of pentolinium tartrate (2 mg./kg. i.v.) blocked all the cardiovascular and respiratory responses. The alkaloidal fraction had a spasmodic effect on the isolated ileum of rabbit ($10^{-6}$ to $2 \times 10^{-5}$). It produced rigidity and convulsions in mice (Das *et al.* ,1961).

A comparative study of the effect of alcoholic extract of the plant and chlorpromazine was carried out on the process of motor learning in rats. A dose of 10 mg./kg. i.p. improved their performance (Prakash and Sirsi, 1962). The tranquillizing property of the extract was found to be weaker than that of chlorpromazine (Ganguly and Malhotra, 1967, 1969). The total extract and alkaloidal fraction inhibited the respiration of rat's brain tissue to a varying degree. LSD-25 and 5-HT did not influence the inhibitory effect of the alkaloidal fraction (Dhalla *et al.*, 1961).

Hersaponin, a glycoside saponin isolated from the plant, had a mild inhibitory action which was, however, found partially reduced by LSD-25 and potentiated by 5-HT (Dhalla *et al.*, 1961). Hersaponin showed a sedative effect in mice. It did not protect rats against electroshock and mice against metrazol seizures. It potentiated the hypnosis produced by hexabarbital, pentobarbital and ethanol in mice and also produced hypothermia. It delayed the rate of disappearance of blood pentobarbital sodium in dogs (Malhotra *et al.*, 1960, 1962). Hersaponin was also found to deplete

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the rat brain of its noradrenaline and 5-HT content, the action being similar to that of reserpine (Malhotra *et al.*, 1961).

The alcoholic extract of the entire plant was found to have anticancer activity against Walker carcinosarcoma 256 (intra-muscular) in rat (Bhakuni *et al.*, 1969).

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## BAMBUSA (Gramineae)

*B. DENDROCALAMUS*

Eng. — Bamboo Tam. — Moongil

**Ayurvedic description**

Sanskrit : *Vamsha*

Synonyms : *Venu, twaksaara, trinadhwaja, shataparva, yavaphala*

Properties : *Rasa* — *Madhura, kashaaya*
*Guna* — *Rooksha, laghu, teekshna, sara.*
*Veerya* — *Sheeta*
*Vipaaka* — *Madhura*

Actions/Uses : *Balya, brihmana, vrishya, vastishodhaka, chedini, kushtaghna, vranaghna, shothaghna, baddhamootraghna, medoghna, vishahara, trishnaahara, kaasaghna, jwaraghna, shwaasaghna, kshayaghna, raktapittahara, kaamalaghna, paandughna, kashtaarthavahara, garbhaashayashodhana.*

**Pharmacology*** : A single oral dose of 25 per cent aqueous extract of the leaves caused a significant lowering of blood sugar in both normal and alloxan-treated rabbits. The effect persisted for about 96 hours (Bapat *et al.*, 1969).

A compound was isolated from the water extract which was soluble in propylene glycol. Its solution also caused significant lowering of blood sugar in both types of rabbits and the hypoglycaemic response was dose-dependent (Bapat *et al.*, 1970).

Fresh juice of the leaves of *B. arundinacea* was tested for uterine activity on isolated human as well as rat uterus. *B. arundinacea* was found to have a weak ecbolic action in doses of 1 to 10 mg./ml., the maximum activity being found at 3 mg./ml. The uterine stimulation appeared to be due to its action on cholinergic receptors (Tewari *et al.*, 1956).

*No report available on other aspects.

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## BANISTEREOPSIS (Malpighinaceae)

*B. ARGENTIA* Spring Ex Juss

**Chemistry :** The alkaloids isolated from the leaves and stem of the plant are : N, N-dimethyl-tryptamine, its Nb-oxide, harmine, harmaline, and Nb-methyltetrahydro-harman, (+)—tetrahydroharmine and(+)5-methoxy-tetrachydroharman. In addition to these, two minor indole 3-ethyl amines together with choline, betaine and a new componund (+)-5-methoxytetrahydroharman have also been reported (Ghosal and Mazumdar, 1971; Ghosal *et al.*, 1971).

**Pharmacology :** Total alkaloids from the leaves showed non-specific spasmolytic action against acetylcholine, histamine and serotonin-induced spasms, histamine release-mediated depressor response and pronounced behavioural effects in guineapigs, frogs and rats (Ghosal *et al.*, 1971).


### References

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## BARLERIA (Acanthaceae)

*B. PRIONITIS* Linn.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Kantajati | Kon. | — | Gorti |
| Guj. | — | Kantaasherio | Mar. | — | Pivala koranta |
| Hind. | — | Catserina | Sans. | — | Vajradanti, karunta |
| Kan. and Tel. | — | Mullu-goranti | Tam. and Mal. | — | Shemmulli |

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**Habitat :** Small spiny bush met within tropical India and found abundant in Bombay, Madras, south India, Ceylon, Assam and Sylhet.

**Parts used :** Whole plant, specially leaves and root.

**Medicinal properties and uses :** Juice of leaves when administered in a little honey or sugar and water is a favourite medicine in catarrhal affections accompanied with fever in children. Juice of leaves of the white variety, mixed with *jeera* is given in spermatorrhoea. The juice is also applied to the feet in the rainy season to prevent their cracking or laceration; mixed with honey, it is applied to bleeding teeth. It is also dropped into the ear in otitis. Paste of the root is applied to boils and glandular swellings. Medicated oil is applied to unhealthy wounds. The plant parts are used in catarrh, cough and anasarca (Nadkarni, 1954).

**Pharmacognosy :** The diagnostic features of the plant have been described. Leaves have a pair of epidermal cells containing calcium carbonate crystals; they have caryophyllaceous stomata having stomatal index on lower and upper surface 23·70 and 0·69 respectively; the palisade ratio is 8·10 and vein-islet number is 9. The periderm of stem bark is subtended by 5-7 layers of tabular collenchyma cells. The phloem rays of stem are of heterogeneous type with uniseriate and multiseriate rays, 8-16 and 8-25 cells high respectively and 2-3 cells broad. Granular and needle shaped calcium oxalate crystals, filling up many cells in almost all tissues of bark are present. In root bark, yellowish cork and sometimes a new phellogen layer separating the outer and inner cortex and root cells containing blackish brown content are present (Datta and Biswas, 1968).

**Pharmacology :** The alcoholic extract of the entire plant *B. cristata* was found to have hypoglycaemic activity in albino rats (Dhar *et al.*, 1968). The extract obtained from *B. cristata* var. *dictrotoma* showed CNS depressant activity in mice. It also produced hypothermia in mice (Bhakuni *et al.*, 1969). A decoction of the leaves of *B. prionitis* in a dose of 2·5 ml./100 g., was found to have moderate diuretic activity in rats compared to urea as the standard drug (Gujral *et al.*, 1955).

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Datta, P.C. and Biswas, Chabi 1968. Pharmacognostic study of the leaf and bark of *Barleria prionitis* Linn. **Quart J Crude Drug Res 8, 1161.**

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*Barleria cristata*

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# BARRINGTONIA (Myrtaceae)

*B. ACUTANGULA* Gaertn.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Samandar | Mar. | — | Pivar |
| Guj. | — | Samudarphal | Tam. | — | Kadappamaram |
| Hind. | — | Hijjal | Tel. | — | Kanapa |

**Habitat :** Throughout India, especially in Sub-Himalayan tracts and in the plains of Bengal.

**Parts used :** Seeds, fruits, roots and leaves.

**Ayurvedic description**

Sanskrit : *Hijjala*

Synonyms : *Vidula, samudraphala, abdhiphala, nichula.*

Properties :

| | | |
|---|---|---|
| *Rasa* | — | *Katu, madhura, tikta* |
| *Guna* | — | *Laghu, rooksha, teekshna* |
| *Veerya* | — | *Ushna* |
| *Vipaaka* | — | *Katu* |

Actions/Uses* : *Rechani, lekhani, krimighna, vishaghna, bhootanaashani, naana-grahanaashani, chakshusraava; kaamala, galaganda, kushtaghna, vedanaasthaapana, raktapitta, ashmari*

**Medicinal properties and uses :** The juice of the leaf is used in diarrhoea and dysentery and as bitter tonic. Root has been found to be cooling, aperient, expectorant and also to possess properties similar to Cinchona (Ahmed, 1969).

**Pharmacognosy :** The macroscopic and microscopic features of the leaf and root have been described.

*Leaf* : The leaves are glabrous, coriaceous, with serrate margin, broad petiole and flat upper surface. The cuticle is thick and the epidermal cells are polygonal in shape. The stomata are ranunculaceous. Cuticular striations are present. In transection the main vascular bundle is in the form of an arc. The ground tissue is formed of parenchyma cells filled with rosette crystals of calcium oxalate. Hypodermis has been recorded in some species but in *B. acutangula* no continuous hypodermis is present. Sub-epidermal cavities containing crystals of calcium oxalate are found. The diagnostic leaf values are : Palisade ratio 5—8—10, Stomatal index 6—5—8·2-11·6, Vein-islet number 4—6—8.

*Note : The special indication for this plant is in psychiatric disorders.

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*Root* : The roots have a tough bark, which can be pealed off easily. It is dark brown externally with longitudinal wrinkles; inner surface is buff or yellowish in colour, fracture is fibrous and fractured surface is uneven and pale yellow.

Cork in transverse section shows 4-6 layers of rectangular, tangentially elongated cells. Phellogen is represented by 1-2 narrow, thin walled tangentially elongated cells. Secondary phloem is arranged in wedge-shaped radiating arms. Metatracheal bands of xylem parenchyma, fibres with thick and lamellated wall, tyloses in vessels and an eccentric pith of parenchymatous fibres are seen. Quantitative microscopic values have been reported (Ahmed, 1969).

**Chemistry :** A new triterpene dicarboxylic acid i.e. barringtonic acid, has been isolated from the ether extract of the plant. The structure of barringtonic acid has been elucidated on the basis of its conversion into barringtogenic acid and ultraviolet and infrared spectral data (Row and Sastry, 1964).

The constitution of barringtogenol C, a new triterpenoid sapogenin isolated from the fruits, has been established (Barua and Chakrabarti, 1965). Two new triterpenes were isolated from ethanolic extract of defatted branchwood. Crude saponin was hydrolysed and from the neutral part of ether extract two triterpenes were isolated on column chromatography. One of these was barringtogenol-E, $C_{44}\ H_{58}O_7$, m.p. 220-21°.

On saponification, barringtogenol E furnished benzoic acid and barringtogenol C. Barringtongenol E is shown to be dibenzoyl derivative of barringtogenol C. The second triterpene $C_{42}H_{62}0_{10}$, m.p. 149-52°, on saponification, furnished benzoic acid and neutral alcohol which on acid hydrolysis yielded barringtogenol C and arabinose. This compound was, therefore, confirmed to be monoarabinoside of barringtogenol C monobenzoate (Barua *et al.*, 1967).

**Pharmacology :** The alcoholic extracts of the roots and stem bark of *B. acutangula* have been found to have CNS depressant activity in mice. Both these extracts produced hypothermia in mice. The root extract also showed hypoglycaemic activity in albino rats whereas the extract of the stem bark showed antiprotozoal activity against *Entamoeba histolytica* (Dhar *et al.*, 1968).

## References

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## BASSIA (Sapotaceae)

*B. LATIFOLIA* Roxb. (Syn. *Madhuca indica J.F.* Gmd.)

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Maua | Mal. | — | Madhookan |
| Eng. | — | Indian butter tree | Mar. | — | Mowda |
| Guj. | — | Mahuda | Tam. | — | Ilupai |
| Hind. | — | Mahua | Tel. | — | Ippachettu |
| Kan. | — | Ippemara | | | |

**Habitat :** Found in Bombay, Central Provinces, Bengal, south Indian forests and Ceylon.

**Parts used :** Flowers, fruits, oil of seeds, leaves and bark.

**Ayurvedic description**

Sanskrit : *Madhooka*

Synonyms : *Gudapushpa, madhudruma, madhushteela, madhusrava, rodhrapushpa, vaanaprasti, deerghapatra, gauravashaaka*

Properties :

| | | |
|---|---|---|
| *Rasa* | — | *Madhura* |
| *Guna* | — | *Guru* |
| *Veerya* | — | *Sheeta* |
| *Vipaaka* | — | *Madhura* |

Actions/Uses : *Brihmana, balya, shukrakara, vrishya, rasaayana, hridya, trishnaashamana, daahashamana, hikkaashamana, shwaasashamana, kshtakshaya, raktapitta, grahani, shiroroga, vranahara.*

**Medicinal properties and uses :** Fresh juice is alterative and the spirit distilled from the flowers is a powerful stimulant, astringent, tonic and appetiser. Flowers are cooling, demulcent, expectorant, tonic, nutritive and stimulant. Liquor obtained from the flowers by distillation contains a large amount of empyreumatic oil which causes gastric irritation in large doses. Leaves and bark have also astringent properties (Nadkarni, 1954).

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**Chemistry*** : Two saponins were isolated from the defatted seeds. Both of them were derived from the triterpene acid, bassic acid. In saponin A, each of the two hydroxyl group at positions 2 and 3 of bassic acid are in β-glycosidic combination with D-glucose, while in saponin B, a complex triose *viz.* rhamnopyranosyl 1→4-xylopyranosyl 1→2-arabopyranose is in ester link with the carboxyl at position 28 of bassic acid. Their structures have been elucidated (Hariharan *et al.*, 1972).

The oil obtained from the seeds of *B. latifolia* yielded a sterol in flakes, m.p. 122°, $C_{29}H_{50}O$ (Bhargava and Singh, 1958).

### References

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## BAUHINIA (Caesalpiniaceae)

*B. TOMENTOSA* Linn.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Kanchan | Mal. | — | Kattatti |
| Guj. | — | Asundro | Mar. | — | Pivala kunchan |
| Hind. | — | Kachnar | Tam. | — | Tiruvaatti |
| Kan. | — | Kadatti | Tel. | — | Adavimandaramu |
| Kon. | — | Chamel | | | |

**Habitat :** Throughout India and Ceylon.

**Parts used :** Whole plant, root, bark, leaves, young flowers, seeds and fruits.

**Ayurvedic description**

Sanskrit : *Ashmaanataka*

Synonyms : *Shlakshnatwak, yamalapatraka, kushalee, anupushpaka*

Properties :

| | | |
|---|---|---|
| *Rasa* | — | *Madhura* |
| *Guna* | — | *Guru* |
| *Veerya* | — | *Sheeta* |
| *Vipaaka* | — | *Madhura* |

Actions/Uses : *Graahi, lekhana, vishaha, chaaturthikavishamajwaraghna, sharkaraashmarinaashaka, bhootabaadhagna, krimighna, kushtaghna, gudabhramshashamana, gandamaalashamana, galagandashamana, vranaapaha, mehaghna, daahashamani, vishahara, kantharogaghna, ateesaraghna, raktavikaarashamana, trishnaashamana, vaantishamana.*

*No report available on other aspects.

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**Medicinal properties and uses :** The whole plant is antidysentric and anthelmintic whereas the fruit is diuretic. The seeds are tonic and aphrodisiac (Nadkarni, 1954).

*B. VARIEGATA* Linn.

| | | | | | |
|---|---|---|---|---|---|
| Ben. and Mar. | — | Rakta-kanchan | Mal. | — | Chuvanna-mandaram |
| Guj. | — | Kovidara | Tam. | — | Shemmandarai |
| Hind. | — | Kachnar | Tel. | — | Daevakanchanamu |
| Kan. | — | Kampu mandana | | | |

**Habitat :** Sub-Himalayan tract and forests of India and Burma.

**Parts used :** Bark, root, gum, leaves, seeds and flowers.

**Ayurvedic description :**

Sanskrit : *Kovidaara*

Synonyms : *Kanchanaara, kaanchana, yamalapatraka, gandaari, yugmapatra, chamarika, apsara, shamya, tarupungava.*

Properties :

| | | |
|---|---|---|
| *Rasa* | — | *Kashaaya* |
| *Guna* | — | *Guru* |
| *Veerya* | — | *Sheeta* |
| *Vipaaka* | — | *Katu* |

Actions/Uses : *Graahi, deepana, vranaropana, mootrakritchrahara, gandamaalaashaamana, gudabhramshashamana, kushtaghna, krimihara.*

**Medicinal properties and uses :** Bark is alterative, tonic and astringent. Root is carminative and flowers are laxative (Nadkarni, 1954).

**Pharmacognosy :** The pharmacognostic studies of *B. variegata* stem have been carried out. The young stem shows four ridges, three of which are more prominent. A few epidermal cells elongate to form multicellular, non-glandular hairs.

Cortex consists of collenchyma followed by parenchyma. The endodermis and pericycle are distinct. The stele is developed below the ridges. After the secondary growth, the stem becomes circular. Pericycle forms strands of thick walled fibres which separate and stone cells are formed in the intervening parenchyma. The bark shows a thick periderm of 15-20 layers of cork cells and wide zone of phello-

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derm, whose cells become thick-walled and sclerenchymatous. The secondary phloem is represented by concentric tangential bands of fibres, sieve tubes, companion cells, and phloem parenchyma separated by funnel-shaped medullary rays. Cortical bundles, fibres of the pericycle, phloem and stone cells of the phelloderm are the distinguishing features of the bark (Prasad and Prakash, 1972).

**Chemistry :** Isoquercitrin and astragalin have been isolated from the fresh flowers of *B. purpurea* with a small amount of quercetin in the free state. Fresh flowers were extracted with methanol by cold maceration twice and the combined extract was concentrated in vacuum. The colouring matter was separated by lead salt technique from the aqueous methanolic extract. Neutral lead acetate precipitate yielded isoquercitrin, m.p. 220-27° and astragalin, m.p. 176-78°, was obtained from basic lead acetate precipitate. Isolation of 5, 7, 3′, 4′, tetramethyl quercetin and 5, 7, 4′-trimethyl kaempferol on methylation followed by hydrolysis confirmed that both colouring matters were 3-glucosides. The presence of these glycosides may, perhaps, account for the medicinal value of the flowers (Ramachandran and Joshi, 1967).

About 4·6 per cent rutin was isolated from the flower petal of *B. tomentosa*. The flowers were air dried and extracted with alcohol and other solvents. From all the fractions, the only major crystalline component isolated was rutin with small amounts of quercetin in the mother liquors (Viswanadham *et al.*, 1970).

**Pharmacology :** The alcoholic extract of the stem bark of *B. racemosa* was found to have anti-cancer activity against human epidermal carcinoma of the nasopharynx in tissue culture. The extract also possessed CNS depressant activity. It produced hypothermia in mice (Dhar *et al.*, 1968). The alcoholic extract of the stem bark of *B. variegata* showed CNS activity. Besides producing hypothermia in mice, it also responded to amphetamine hyperactivity test (Bhakuni *et al.*, 1969).

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# BERBERIS (Berberidaceae)

*B. ARISTATA* DC.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Darhaldi | Mar. | — | Daruhalad |
| Eng. | — | Indian or Nepal or Ophthalmic Burberry; Tree-tumeric | Punj. | — | Sumlu |
| Hind. | — | Rasaut | Tam. and Mal. | — | Maramanjal |
| Kan. | — | Doddamaradarisina | Tel. | — | Kasturipaspu |

**Habitat :** Berberry bushes grow on the Nilgiris and all over temperate Himalayas, from Bhutan to Kunawer.

**Parts used :** Fruit, root-bark, stem and wood.

**Ayurvedic description**

Sanskrit : *Daaruharidra*

Synonyms : *Daarunisha, daarvee, pachampacha, katamkateri, parjanya, kutajavat-patra, ankolasadrishi, ksheerinee, peeta, kaleeyaka, haridra, peetadaaru*

Properties :
*Rasa* — *Katu, tikta*
*Guna* — *Rooksha*
*Veerya* — *Ushna*
*Vipaaka* — *Katu*

Actions/Uses : *Lekhani, shodhani karnarukshamani, netrarukshamani, mukharukhara, kandoohara, vranahara, meharogaghna, raktadoshahara, twagdoshahara, shothahara, paanduhara, krimighna, vishadoshaghna, peenasahara, aruchishamana, apacheehara, varnakari*

**Medicinal properties and uses :** The plant is used as tonic, stomachic, astringent, antiperiodic, diaphoretic, antipyretic and alterative. Root-bark is purgative (Chopra *et al.*, 1956; Nadkarni, 1954).

*B. ASIATICA* Roxb.

Hind. — Kilmora

**Habitat :** Grows in dry valleys of the Himalayas in Bhutan, Gharwal, Bihar, and on the Parasnath Hill, Afghanistan.

**Parts used :** Root, fruit, stem.

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**Medicinal properties and uses :** Stem is diaphoretic and laxative while the root-bark is tonic and antiperiodic (Nadkarni, 1954).

*B. LYCIUM* Royle

Hind. — Kashmal Mar. — Darhalad

**Habitat :** Grows in dry hot places in western Himalayas from Garhwal to Hazara.

**Parts used :** Root, stem and leaves.

**Medicinal properties and uses :** The root is febrifuge, carminative and gentle aperient (Nadkarni 1954). Interest has been aroused in Berberine-containing plants on account of its successful use in the treatment of cutaneous leishmaniasis i.e. oriental sore (Chopra *et al.*, 1958 ).

**Chemistry :** From the roots of *B. asiatica*, berberine, palmitine, jatrorrhizine, columbamine, tetrahydropalmitine, berbamine, oxyberberine, and oxyacanthine were isolated. Berberine and palmitine were found as chlorides (Bhakuni *et al.*, 1968).

A new compound isolated from *B. lycium* has been shown to be identical with berberine-acetone complex in all respects. This species has been considered to be a good source of berberine (Sahdev *et al.*, 1971).

**Pharmacological and clinical studies :** The alcoholic extract of the roots of *B. aristata* showed hypoglycaemic activity in albino rats. The extracts of *B. asiatica*, *B. aristata* and *B. lycium* possessed anti-cancer activity in human epidermal carcinoma of the nasopharynx in tissue culture. The extract of *B. lycium* also showed anti-protozoal activity against *Entamoeba histolytica* and anti-viral activity against *Ranikhet disease virus*. It also possessed anti-convulsant activity against supramaximal electroshock seizure (Dhar *et al.*, 1968).

Berberine hydrochloride, an alkaloid isolated from *B. aristata*, was found to have significant anti-inflammatory activity on acute, subacute and chronic types of inflammations produced by immunological and non-immunological methods (Halder *et al.*, 1970).

In oestrogenized rat uterus, berberine reduced the contractions induced by 5-HT by 50 per cent in a dose of 30 mcg./ml. Berberine produced reversible and dose-dependent hypotensive activity in anaesthetized dog, cat, rat and frog. The hypotensive action could not be blocked by atropine, mepyramine, phenoxy-benzamine, propranolol, pentolinium or by bilateral vagotomy and ablation of brain. A combination of propranolol-pentolinium, however, blocked this effect in some dogs. It did not alter the actions of carbachol, histamine, bradykinin, isoprenaline, adrenaline and noradrenaline on blood pressure. The hypotensive activity of berberine appeared to be due to its

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action directly on blood vessels. It stimulated dog's heart *in situ* and in smaller doses, stimulated isolated heart of rabbit and frog. Berberine in 10 mg./kg. dose increased the rate and amplitude of the respiration of dog. It lowered the rectal temperature, reduced spontaneous motor activity and prolonged hexabarbitone sleeping time in mice. It had local anaesthetic action on guineapig's eye. It blocked the pendular movements of the rabbit jejunum. Berberine markedly potentiated the magnitude of contractions induced by acetylcholine on rectus abdominis muscle of frog. $LD_{50}$ of berberine sulphate in mice, intraperitoneally, was found to be 24·3 mg./kg. (Sabir, 1969; Sabir and Bhide, 1971*a*).

Chronic oral (20 mg./kg.) and intramuscular (2 mg./kg.) administration of berberine sulphate to rats increased the duration of pentobarbitone-induced sleeping time and decreased serum cholesterol levels (Vad *et al.*, 1970).

Berberine showed marked effectiveness against intestinal amoebiasis in rats and hepatic amoebiasis in golden hamsters (Dutta and Iyer, 1968). It prevented death of young rabbits suffering from cholera when given at an early stage (Dutta and Panse, 1962). The action of berberine on *Vibrio cholerae* was found to be bacteriostatic in nature in early stages of growth of the organisms. The mechanism of its action appeared to be due to membrane damage during initial static period due to leakage of the intercellular constituents. The crude toxin made from berberine treated vibrios failed to produce choleraic symptoms in the infant rabbit model which suggested that the toxin was either inactivated or neutralized. The uptake of precursors of protein and nucleic acids was restricted in the static period. The biotype *El-tor* strain of *V. cholerae* was found to be more resistant to the action of berberine than the classical type. This could be explained on the basis of differential absorption of berberine by the two strains. The pattern of intra-cellular distribution of berberine was found to be the same for both the strains, its major portion being associated with lipids. During the static period, an inhibition of the synthesis of all macromolecules, particularly the nucleic acids, was observed, but once the growth started, the nucleic acid synthesis reached almost the same level as the normal untreated cells. The synthesis of all the RNA subfractions was inhibited to the same extent (Nair *et al.*, 1969; Modak *et al.*, 1970*a*). Berberine was found to bring about changes in the ratios of saturated and monounsaturated acids in the fatty acid composition of *V. cholerae* (Nair *et al.*, 1969). It was observed that the classical strain had palmitic acid as major acid as against the $C_{18} : 1 : 1$ of *V. cholerae* biotype *El tor*. This normal pattern was altered by the action of berberine by creating an imbalance of the fatty acids of all the lipid fractions which possibly resulted in the alteration of the toxin molecule (Modak *et al.*, 1970*b*).

Berberine hydrochloride had a depressant effect on the response induced by histamine, bradykinin and 5-HT. It was observed that berberine acted in severe diarrhoeas and cholera by reducing the increased capillary permeability (Bhide and Dutta, 1968).

Berberine (1-3 mg.) neutralized *in vitro* the anti-coagulant action of 50 i.u. of heparin/ml. of dog's and human blood. Larger doses (10 mg./ml.) had a paradoxical

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anticoagulant action. The activity was found similar to that produced by protamine sulphate and toluidine blue (Sabir and Bhide, 1971*b*).

Studies on the absorption, distribution and excretion of berberine in infant rabbits revealed that, when administered orally, berberine was absorbed through the gastro-intestinal tract. After intramuscular injection, berberine was found in the heart, kidney, liver as well as large and small intestines. It was excreted in the stool and urine. The absorption and distribution of berberine in rabbits treated with cholera toxin was similar to that in infected animals. In infected and toxin-treated animals, blood levels were lower and tissue levels in liver and kidney were higher (Bhide *et al.*, 1969).

Clinical studies with berberine were conducted in 356 patients of cholera and compared with 264 patients treated with chloramphenicol. Berberine was found to be effective in both bacteriologically positive and negative patients. It reduced the mortality rate, volume and duration and diarrhoea, intake of intravenous fluid and the convalescence period. Berberine was found to be better than chloramphenicol in this respect. It showed no side effects or toxicity in the doses tried. Initial doses were 15 mg. 6 hourly for 2 days, 8 hourly on the 3rd day and only one dose on the 4th day. Later, the doses were increased to 50 mg. on admission, 50 mg. every 8 hours on the first two days, followed by 50 mg. twice daily till the 4th or 5th day. The possible mechanism of action of berberine in cholera has been proposed to be its neutralizing action on the diarrhoea-producing component. The choleragenic fraction isolated from *V. cholerae* has been found to be responsible for diarrhoeal symptoms in man. (Lahiri and Dutta, 1967).

Twenty five patients of giardiasis were treated with berberine in a dose of 5 mg./kg. per day for 6 days, and the results compared with those of metronidazole given in a dose of 10 mg./kg./day for 6 days in 9 patients. Twenty patients receiving vitamin B complex syrup for 6 days served as the controls. Twelve patients receiving berberine, 3 receiving metronidazole and 3 receiving vitamin B complex showed relief of clinical symptoms. The stools became free of giardia in 17 patients receiving berberine, 9 receiving metronidazole and 5 receiving B complex (Choudhury *et al.*, 1972).

Berberine was found to be effective in controlling gastroentritis in 50 children. It was a good antidiarrhoeal agent and could be easily administered in children in the form of palatable suspension. The drug was free from any serious toxicity (Sharada, 1970).

Umbellitin, isolated from the stem bark of *B. umbellata*, was found to have specific inhibitory action on the growth of *Leishmania tropica*. Like berberine, umbellitin is not a protoplasmic poison (Chopra *et al.*, 1958).

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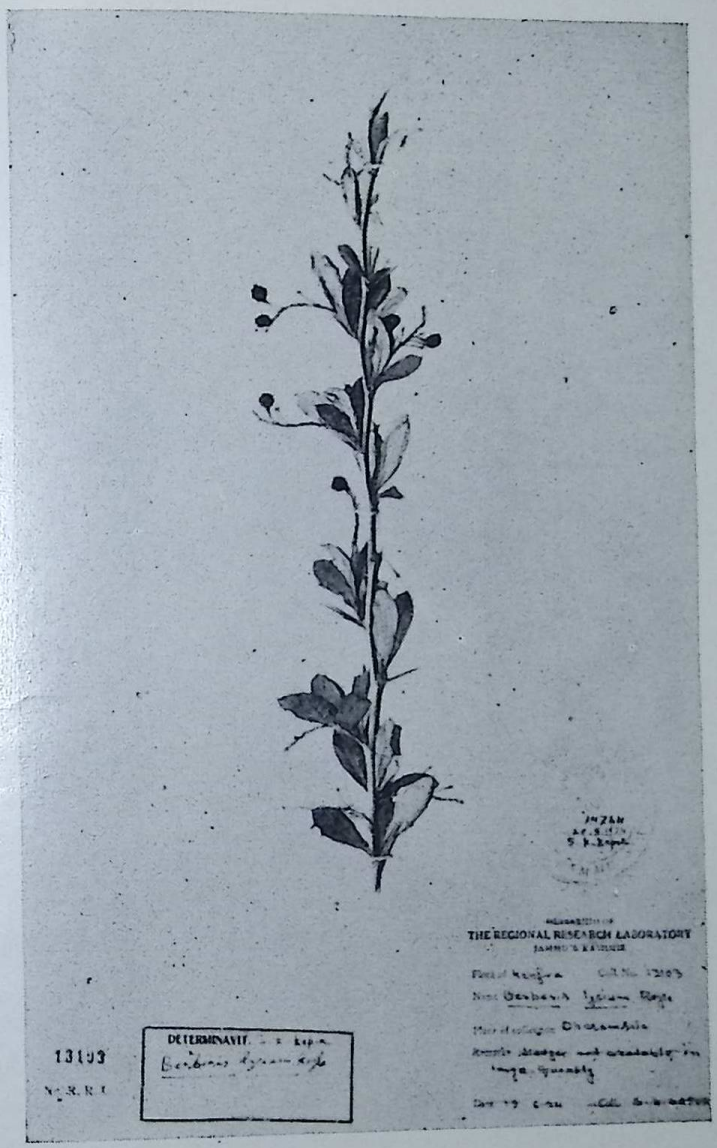


*Berberis lycium*

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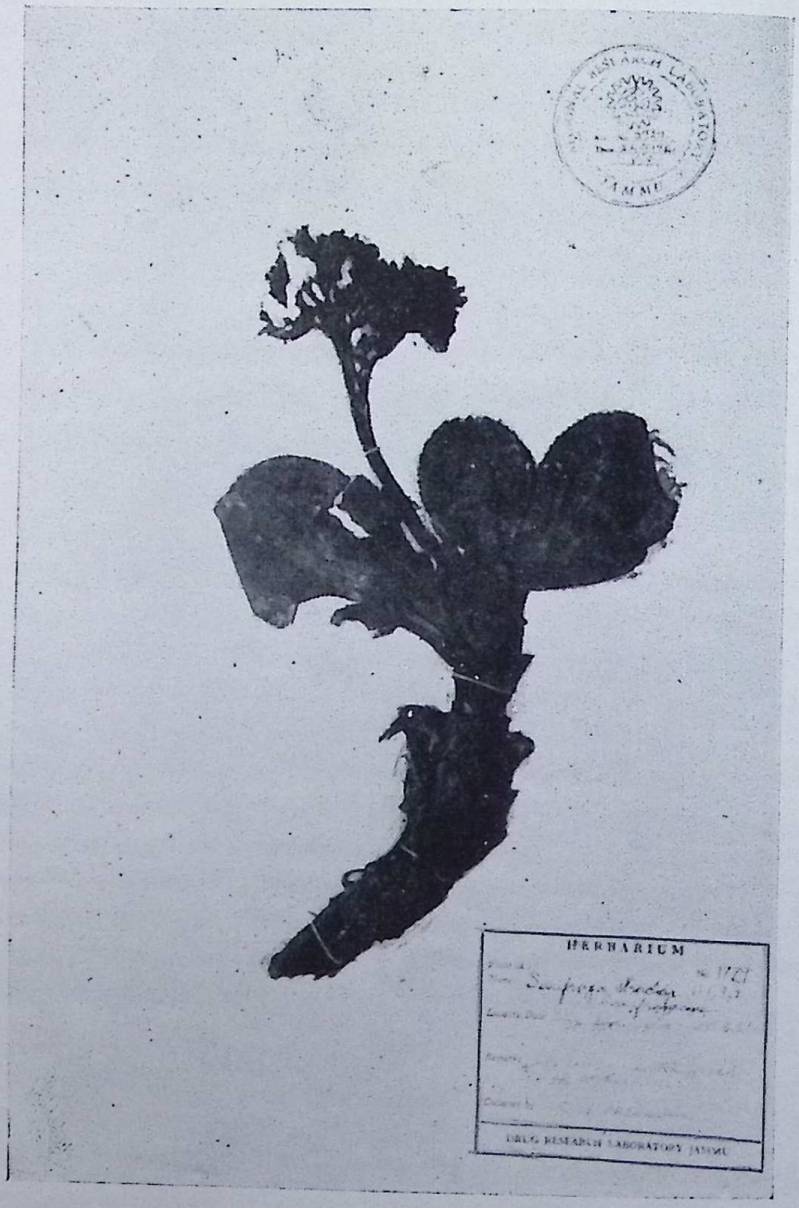


*Bergenia stracheyi*

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## BERGENIA (Saxifragaceae)

*B. CILIATA* Blatter (Syn. *Saxifraga ciliata* Wall).

Ben. — Patharchuri
Hind. — Pashanbed
Mar. — Pashanbheda

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**Habitat :** All the three species *viz. B. ciliata, B. ligulata* and *B. stracheyi* are distributed in temperate Himalayas from Kashmir to Bhutan above 1500 m. These are perennial herbs, growing in moist and shady places, closely appressed to rocks.

**Parts used :** Rhizomes

**Ayurvedic description**

Sanskrit : *Paashaanabheda*

Synonyms : *Ashmaghna, vatapatree, shweta, shilaavalkala, chatushpatree, parvati*

Properties :

| | | |
|---|---|---|
| *Rasa* | — | *Kashaaya, tikta* |
| *Guna* | — | *Laghu, snigdha, teekshna* |
| *Veerya* | — | *Sheeta* |
| *Vipaaka* | — | *Katu* |
| *Prabhaava* | — | *Ashmabhedana* |

Actions/Uses : *Bhedana, vastishodhana, shoolahara, mootrakritchrahara, mehaghna, sharkaraanivaarana, shishnashoolaghna, vranaghna, hridrogaghna, pleeharogaghna, gulmarogahara, arshorogaghna.*

**Medicinal properties and uses :** All the species of *Bergenia* are reported to dissolve gravel and stones in the kidney. Root is used as tonic, in fever, diarrhoea, pulmonary-affections, as anti-scorbutic and in ophthalmia. The drug is also applied to boils and thus in some villages of Kashmir, it is popularly known as "Zakham-e-hayat" (Mehra and Raina, 1971).

**Pharmacognosy :** *Paashaanbheda* comprises the dried rhizomes of the three species of *Bergenia viz. B. ligulata, B. ciliata* and *B. stracheyi.* The external morphology of the rhizomes of all the three species is the same. Macroscopical characters of the leaves of the three species serve to differentiate one species from the other. Microscopically also, a few distinguishing characters differentiate the species. *B. ligulata* in transection shows wide cortex of thick parenchymatous cells with starch grains and tanniniferous contents and a few rosette crystals of calcium oxalate. The vascular bundles are found in a ring. Some of the pith cells in the central portion have pitted walls. The rhizomes of *B. stracheyi* have irregular outline and central zone consists of secondary wood in which xylem elements are arranged in rows forming streaks. Central small pith becomes cut off from the vascular zone by the formation of internal cork cambium. No significant anatomical differences are found between the rhizomes of *B. ligulata* and *B. ciliata* (Mehra and Raina, 1971).

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**Chemistry :** Chemical studies were conducted on the rhizomes and leaves of *B. ciliata*, *B. ligulata* and *B. stracheyi*. From the roots of *B. ciliata*, β-sitosterol, bergenin and galloylated leucoanthocyanidin-4-(2-0-galloyl) glucoside were isolated. The leaves contained two commonly occurring flavonols, quercetin and kaempferol along with their 3-rhamnosides quercitrin and afzelin. Arbutin derivatives and β-sitosterol have also been found in the leaves of *B. ciliata*.

From the roots of *B. ligulata* only bergenin and β-sitosterol could be identified. The roots of *B. stracheyi* were found to contain a new catechin derivative, (+) catechin-3-gallate, in addition to the common consituents β-sitosterol and bergenin (Bahl and Seshdari, 1970; Bahl *et al.*, 1974).

**Pharmacology :** The aqueous, alcoholic and acetone extracts of the roots of *B. ciliata* each in a dose of 20 mg./kg. intravenously, produced transient fall in blood pressure of anaesthetised dogs. Only alcoholic extract potentiated pentobarbitone-induced hypnosis in mice in a dose of 50 mg./kg. An oral dose of 0·5 g./kg. of alcoholic extract showed a significant diuretic activity in rats. However, its potency was found to be less than that of urea, 0·95 g./kg. orally (Sharma, 1970).

The alcoholic extract of the rhizome of *B. ligulata* showed anti-cancer activity in Walker carcinosarcoma 256 in rat. It also showed anti-protozoal activity against *Entamoeba histolytica* (Dhar *et al.*, 1968).

The alcoholic and aqueous extracts of *B. ligulata* produced hypotension in rats which could be blocked by mepyramine maleate only. The extracts exerted a positive chronotropic and inotropic effect on frog's heart. On continuous rabbit's heart perfusion, the extracts showed negative inotropic and chronotropic effect with a reduction of coronary flow. The alcoholic extract elicited marked anti-bradykinin activity both *in vivo* and *in vitro*, but did not modify the response of 5-HT and acetylcholine on isolated guineapig ileum. It potentiated the action of adrenaline on guineapig tracheal chain and ileum. The aqueous extract had some diuretic effect in rats. The $LD_{50}$ of the aqueous extract was found to be 650 mg./kg. intraperitoneally. The extracts showed insignificant anti-lithic activity in dissolving stones produced in male rats (Maurya *et al.*, 1972).

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## BIXA (Bixaceae)

*B. ORELLANA* Linn.

| | | | | | |
|---|---|---|---|---|---|
| Eng. | — | Annatto | Hind. and Ben. | — | Latkan |
| Mar. | — | Shendri | Tam. and Tel. | — | Japhara |

**Habitat :** Cultivated to a small extent in Mysore and is grown in Indian gardens as a hedge plant. It occurs wild in Travancore, Coramandal and Malabar coasts and in some districts of Bombay, Bengal and Assam.

**Parts used :** Fruit, root, seed and leaves.

**Medicinal properties and uses :** Fruits are astingent and purgative. Root-bark is antiperiodic, febrifuge and antipyretic. It is considered to be a good remedy for gonorrhoea. Leaves are used in jaundice and snake-bite (Chopra *et al.*, 1956). Bixin is the colouring matter covering the seeds and is used for colouring butter.

**Chemistry* :** Bixin has been isolated by a simplified method by boiling the entire seeds with acetone or ethyl acetate. Labile bixin was obtained as red prismatic needles, m.p. 197-99°. It gave cornflower blue colour when treated with concentrated sulphuric acid (Bahl *et al.*, 1971).

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*No report available on other aspects.

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# BOERHAAVIA (Nyctaginaceae)

*Punarnava* has been known to be a controversial plant. Three species of *Boerhaavia* have been used as *Punarnava* in different parts of India *viz.*, *B. diffusa*, *B. erecta* and *B. repanda*, the white flowered species being identified as *Punarnava* (Saha and Krishnamurthy, 1962). Although *B. diffusa* and *B. erecta* were recorded as synonymous by Watt (1889), Sircar (1944) was of the opinion that *B. diffusa* is a different plant identified with *Kanthillaka*. *Trianthema portulacastrum* was, in fact, considered by him as *Punarnava*, the white flowered variety being equivalent to *Sweta punarnava* and the red one being equivalent to *Rakta punarnava*. Cooke (1958) recorded only *B. repanda* as *Punarnava*. *Trianthema portulacastrum* closely resembles *B. diffusa* and is often adulterated with it in the market. The stem and leaf characteristics of these two species have been compared (Prasad, 1948).

*B. DIFFUSA* Linn. (Syn. *B. repens* Delile)

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Gandhapurna | Mal. | — | Tamilana |
| Eng. | — | Spreading hog-weed | Mar. | — | Punarnava |
| Guj. | — | Vakhakhaparo | Punj. | — | Itsit |
| Hind. | — | Beshakapore | Tam. | — | Mukkarattai, saattaranai |
| Kan. | — | Sanadika, Komme | Tel. | — | Attatamamidi |

**Habitat :** All over India, abundant during rains. It is a diffuse herb with a stout woody root stalk and erect or procumbant branches (Nadkarni, 1954).

**Parts used :** Whole herb and root.

**Ayurvedic description :**

Sanskrit : *Punarnava* (*shweta*)

Synonyms : *Shothagna, varshaabhu, vrishcheeva*

Properties : *Rasa* — *Madhura, tikta, kashaaya*
*Guna* — *Laghu, rooksha*
*Veerya* — *Ushna*
*Vipaaka* — *Madhura*

Actions/Uses : *Shothahara, mootrala, hridya, raktavardhaka, rasaayana, vyasthaapana kaasahara, swedopaga*

*Punarnava* (*rakta*)

Properties : *Rasa* — *Madhura*
*Guna* — *Laghu, rooksha*
*Veerya* — *Sheeta*
*Vipaaka* — *Katu*

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**Medicinal properties and uses :** It is bitter, stomachic, laxative, diuretic, expectorant, diaphoretic and emetic. Root is purgative, anthelmintic and febrifuge. White variety has laxative and diaphoretic properties and the red variety is bitter (Nadkarni, 1954). Used in jaundice, ascites, anasarca and scanty urine (Surange and Pendse, 1972).

*B. REPANDA* Willd.

**Habitat :** Grows in upper Gangetic plain and Rohilkund. Subscandent branched herb.

**Parts used :** Root and leaves.

**Medicinal properties and uses :** Same as for *B. diffusa.*

**Pharmacognosy :** Pharmacognostic studies of *B. diffusa* have been carried out.

Macroscopic characters : The tap root is long, tuberous, tapering. Leaves are opposite, glabrous, margins undulate. Flowers are hermaphrodite, pedicellate. Bracts are deciduous, involucrate. Fruit is detachable, embryo curved and radicle is long.

Microscopic characters : The stem epidermis is single layered with multicellular hairs. The cortex has outer collenchymatous layer and inner endodermis; pericycle is many layered. Vascular bundles are collateral, open, endarch and irregularly distributed. Stem shows anamolous secondary growth and long needle-like crystals are present. Leaf is dorsiventral and multicellular epidermal hairs are present. Stomata are present on both the surfaces, palisade is 1-3 layered with numerous chloroplasts, crystals are present.

In root, epiblema has numerous unicellular hairs. Endodermis and pericycle are single layered. Young root is diarch to tetrarch and conjunctive tissue is parenchymatous. Polygonal cells containing starch grains are present. Centre of root is occupied by primary xylem. Long needle-like crystals are present in root also. They completely fill up the cells and give a characteristic appearance (Haravey, 1967).

A brief review of the identification of *Punarnava* has been given. Pharmacognosy of the root of *B. repanda* has also been described.

Macroscopic characters : The root system of *B. repanda* is very well developed unlike in *B. diffusa.* The root is single, thick, deep penetrating, brown, bearing rootlets. Lenticles are present.

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Microscopic characters : In transection 4-8 layers of cork are seen followed by phellogen of 2-3 layers of cells. Phelloderm and raphides are also present. Vascular tissue is embedded in ground parenchyma cells. The bundles are in two or three rings (Surange and Pendse, 1972).

Work done on the basis of a year wise local field survey and local drug market survey conducted at Varanasi has shown that *Punarnava* is a controversial drug. The main plants used in the name of *Punarnava* in this area are *Boerhaavia diffusa* and *Trianthema monogyna*. On the basis of Ayurvedic textual descriptions, morphological and ecological characters, *Punarnava* has been identified as *Boerhaavia diffusa*. The red flowered variety has been equated to *Rakta Punarnava* and the white flowered variety to *Sweta Punarnava*. The plant *Trianthema monogyna* has been identified with another Ayurvedic durg *Varshaabhu*. It has been concluded that *Punarnava* and *Varshaabhu* described as synonymous in Ayurveda are two different drugs possibly with similar therapeutic effects (Singh and Udupa, 1972*a*).

**Chemistry :** Authentic specimens and market samples of *B. diffusa* were extracted with various solvents and compared by TLC. The allied species were also studied. On chromatographic studies, the extracts were found to contain β-sitosterol, α-2-sitosterol, an unidentified alcohol, palmitic acid ester of β-sitosterol, tetracosanoic, hexacosanoic, stearic, palmitic and archidic acids. A nitrogenous compound was isolated from the alcohol extract which was identified al allantoin (Sukhdev, 1970).

Hentriacontane, β-sitosterol and ursolic acid have been isolated from roots of *B. diffusa* (Misra and Tiwari, 1971).

In preliminary phytochemical studies, sterols were found to be present in water insoluble portion of *B. diffusa* (whole plant) which was shown to be a mixture of two or more such compounds (Singh and Udupa, 1972*b*).

A sterol isolated from the root was identified as β-sitosterol (Srivastava *et al.*, 1972). Phytochemical tests on *B. repanda* showed the presence of proteins, reducing sugars and alkaloids. Quantitative assay for alkaloids showed 0·1 to 0·15 per cent of total alkaloids in the root (Surange and Pendse, 1972).

**Pharmacological and clinical studies :** The total alcoholic extract of *B. diffusa* was found to have significant anti-inflammatory activity against carageenin-induced hind paw oedema in rats. The activity was more significant in non-water soluble portion of the total extract. A fat soluble active fraction of the petroleum ether extract of the drug also showed significant inhibitory effect on carageenin-induced hind paw oedema. Similar effects were noted when these drugs were tested against carageenin-induced granuloma pouch in rats (Singh and Udupa, 1972*c*).

The aqueous and acetone extracts of the roots in a dose of 4 mg./100 g. each, showed significant anti-inflammatory activity on carrageenin-induced oedema and formaldehyde-induced arthritis in albino rats. An alkaloid (punarnavine) isolated from

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the roots was found less active than the acetone extract. The aqueous extract and the alkaloid significantly inhibited the increased serum aminotransferase activity in arthritic animals similar to hydrocortisone. They increased the liver ATP phosphohydrolase activity (Bhalla *et al.*, 1968, 1971).

The total alcoholic extract showed a cardiotonic effect in perfused frog heart preparation and anaesthetized dog heart *in situ*. An increase in the blood pressure of anaesthetized dogs was observed with the total extract. The extract also showed relaxant effect on the rabbit ileum and could partially block the effect of acetylcholine. The water-soluble fraction of the total extract showed distinct stimulatory effect while the water in soluble fraction showed notable relaxant effect.

The total extract and its water-soluble and water-insoluble fractions also increased urinary output in rats, the action of non-water soluble fraction being more potent. The fat-soluble active fraction from petroleum ether extract also possessed diuretic effect (Singh and Udupa, 1972*c*).

A promising diuretic activity of alcoholic and aqueous extracts and the active principle of *B. repens* and *B. repanda* was found in saline-loaded albino rats when urea was used as a standard diuretic for comparison. The results were calculated on quantitative estimation of the intake and output of chloride (Haravey, 1966).

The drug in the form of a powder or an aqueous decoction was found to be useful in the treatment of nephrotic syndrome in 22 patients. The drug compared well with known drugs like corticosteroids. The drug induced diuresis in these patients. Besides relief in clinical oedema, these patients also showed over-all improvement, such as decrease in albuminurea, rise in serum protein and fall in serum cholesterol level (Singh and Udupa, 1972*d*).

A double blind clinical trial was conducted to study the effect of *B. diffusa* on 43 normal adults aged between 45-50 years. The drug was used in the form of powdered whole plant made into tablets, using starch tablets as placebo. Periodical examination was conducted at an interval of three months. A slight decrease in the mean level of R.B.C., percentage of haemoglobin and vital capacity as well as moderate decrease in the mean level of blood urea and serum acid phosphatase was observed in the patients receiving the drug (Appa Rao *et al.*, 1967).

Further clinical studies were conducted in which a double blind clinical trial was undertaken on 24 healthy individuals in the age group of 45-50 years to study the *rasaayana* (anabolic) effect of *Punarnava* (*Boerhaavia diffusa*) over a period of 42 months. It was seen that the drug did not show any appreciable effect on the blood constituents in the initial examination (*i.e.* till three periodical examinations at an

*Note* : The plant considered to be useful in the treatment of eye diseases has been identified as *Boerhaavia verticillata*, which was found to contain a sapogenin and an alkaloid, punarnavine, in much larger quantities than *B. diffusa* and *Trianthema monogyna*, also a source of *Sweta Punarnava* (Srivastava, 1968).

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*Boerhaavia diffusa*

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*Buddlieia paniculata*

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interval of three months). Subsequent examinations, however, showed that the drug effected appreciable decrease in blood urea with a simultaneous increase in serum-cholesterol and blood sugar (Appa Rao *et al.*, 1969).

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## BOMBBX (Bombecaceae)

*B. CEIBA* Linn. (Syn. *Salmalia malabarica* Schott and Endl., *Bombax malabarium* DC)

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Roktosimul | Mar. | — | Semul |
| Hind. | — | Simul | Tam. | — | Purani, elavam |
| Mal. | — | Mocha | Tel. | — | Salmali |

**Habitat :** Throughout the hotter parts of India

**Parts used :** Root, stem, leaf and flowers.

**Ayurvedic description**

Sanskrit : *Shaalmalee*

Synonyms : *Mocha, toolinee, sthiraayuhu, pooranee, pichchila, rochana, raktapushpa*

Properties : *Rasa* — *Madhura, kashaaya*
*Guna* — *Snigdha*
*Veerya* — *Sheeta*
*Vipaaka* — *Madhura*

Actions/Uses : *Graahi, vrishya, balya, raktasthambhana, vedanaasthaapana, rasaayani, shuklavardhani, pramehaghna, pravaahikashamana, ateesaarashamana, daahashamana.*

**Medicinal properties and uses :** Root is stimulant and tonic, gum is aphrodisiac, demulcent, haemostatic and astringent and flowers and fruits are used in snake-bite. (Chopra *et al.*, 1956).

**Pharmacognosy :** Macro and microscopic characters of the root, stem and leaf have been studied. The structure was found to be that of a typical dicot. in root and stem. But they were charac terised by the presence of concentric series of fibrous patches alternating with groups of sieve elements in the secondary phloem. Some other

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distinguishing features of the plant are the presence of mucilage canals, tannin cells and cells containing rosette crystals of calcium oxalate in the ground tissue of the root and stem. Pharmacognostic constants such as ash values, stomatal index, palisade ratio of the leaf were also determined (Mehra and Karnik, 1968).

**Chemistry :** Preliminary phytochemical tests showed the presence of glycosides and tannins in the root, stem and leaf. The stem in addition showed some alkaloids while the root revealed the presence of proteins (Mehra and Karnik, 1968). The isolation of lupeol and β-sitosterol from the petroleum ether extract of the stem bark has been reported (Mukherjee and Roy, 1971).

From the root bark, three naphthalene derivatives have been isolated. They all contained a methyl group at 3 and isopropyl at 6 and oxygen functions at 1, 6 and 7 positions as the common feature and are thus related to gossypol, the characteristic pigment and toxic principle of cotton seed. One of the compounds isolated was the 1, 7-dihydroxy-6-methoxy compound and was thus the 6-methyl ether of 'semigossypol', (which is 1, 6, 7-trihydroxy compound). Another was the 1, 4-quinone of 'semigossypol' and the third the 6-methyl ether of this quinone (Seshadri *et al.*, 1971, 1973).

The flowers contained β-D-glucoside of β-sitosterol, free-β-sitosterol, hentriacontane, hentriacontanol, traces of essential oil, kaempferol and quercetin (Harish Gopal and Gupta, 1972).

**Pharmacology :** Hot aqueous extract of the seeds showed moderate oxytocic activity on gravid and non-gravid isolated rat uteri and on guineapig and rabbit uterine strips. It was found to have musculotropic action in guineapig ileum and cardiac stimulant action on frog's heart *in situ*. The $LD_{50}$ in albino rats was found to be 3.63 g./100 g. intra-peritoneally (Misra *et al.*, 1968).

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# BOSWELLIA (Burseraceae)

*B. SERRATA* Roxb.

Ben. and Hind. — Luban, salai  Tam. and Tel. — Parangisaambraani

**Habitat :** Found in Madhya Pradesh, Deccan, Bihar, Orissa and North Gujrat.

**Parts used :** Gum.

**Ayurvedic description**

Sanskrit : *Shallaki*

Synonyms : *Susrava, kundurookee, gajabhakshya, naagavadhoo, nimbapatra, mahaataru, peeta, pichcha, kundaru, suvaha, surabhi, maherana.*

Properties : *Rasa* — *Madhura, tikta, katu*
*Guna* — *Guru, snigdha*
*Veerya* — *Sheeta*
*Vipaaka* — *Madhura/katu.*

Actions/Uses : *Vranahari, pushtikaari, graahi, pakwaateesarashamana, raktapitta-shamana, jwaraapaha, swedaapaha, pradaranaashakara, sharkaraa-mehashamana, arshoghni, kushtaghni, aruchishamana.*

**Medicinal properties and uses :** The gum is used as diaphoretic, diuretic, astringent, emmenagogue, in rheumatism, nervous and skin diseases (Chopra *et al.*, 1956).

**Pharmacology* :** The alcoholic extract of the root possessed anti-cancer activity against human epidermal carcinoma of the nasopharynx in tissue culture. CNS depressant activity was observed with the alcoholic extract of roots as well as fruits in mice. The extracts of both fruits and stem showed hypoglycaemic activity in albino rats (Dhar *et al.*, 1968).

The non-phenolic fraction of the gum resin of *B. serrata* exhibited marked sedative and analgesic effects. The fraction produced a reduction in spontaneous motor activity and caused ptosis in rats. A significant analgesic effect was observed as evaluated by both the hot-wire and mechanical pressure methods. The fraction potentiated secobarbitone-induced hypnosis in rats. The secondary conditioned response was specifically blocked in the trained rats, whereas the conditioned avoidance response was not significantly affected (Menon and Kar, 1971).

*No report available on other aspects.

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## BOUCEROSIA (Asclepiadaceae)

*B. AUCHERIANA* Decne.

Punj. — Charungli, pamanke

**Habitat :** Dry hills of western Punjab, Waziristan and Baluchistan.

**Parts used :** Stem.

**Medicinal properties and uses :** Juicy stems are bitter tonic, febrifuge, stomachic, carminative and also useful in rheumatism (Chopra *et al.*, 1956).

**Chemistry* :** From the aerial parts of *B. aucheriana*, 1, 26-hexacosandiol, $C_{26}H_{54}O_2$, m.p. 110°, a new wax designated as boucerosin, $C_{70}H_{138}O_4$., m.p. 89° and a saponin were isolated. The former two were isolated from petroleum ether extract, and the latter from chloroform extract. On hydrolysis, boucerosin furnished behenic acid $C_{22}H_{44}O_2$ and 1, 26-hexacosandiol (Chatterjee and Chakraborty, 1967).

**Reference**

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## BRAGANTIA (Aristolochiaceae)

*B. WALLICHII* R.Br. (Syn. *Apama silliquosa* Linn.)

Mal. — Alpam
Mar. — Chakrani
Tel. — Tellayeshwari

**Habitat :** Deccan Peninsula, common in the evergreen forests around Gersoppa falls and in S. Konkan.

**Parts used :** Roots and leaves.

*No report available on other aspects.

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**Medicinal properties and uses :** The plant is a sedative while roots are given in cholera, diarrhoea and dysentery. Plant mixed with oil and made into an ointment is reported to be beneficial for carbuncles and inveterate ulcers (Chopra *et al.*, 1956; Nadkarni, 1954).

**Pharmacognosy :** The pharmacognostic characters of the plant have been described. The roots of the plants were observed to grow very long in comparison to stem and is tortuous, profusely branched, greyish cream with an oily odour and a bitter taste. Deep longitudinal fissures appear on the surface of the root resulting in the formation of prominent elongated islands, pointed at both the ends, lenticels being quite large. The root bark in transection has 4-10 layers of rectangular to squarish thick walled cells with a dark brown deposit. Stellar cylinder is very prominent, medullary rays are very broad and have hexagonal cells. The powder of the root is yellowish green. Bark cells are impregnated with tannin and cork cells with subrin. Starch is present in the cells of pericycle. Medullary ray cells have abundance of starch and sugars. Some of the cells are sclerosed (Singh, 1966; Deshmukh and Pandit, 1966).

**Pharmacology :** The plant was tested for vibriocidal as well as anti-cholera activity. None of the extracts had any vibriocidal activity, although the pure base was active *in vitro* against *S. typhi* and *E. coli*. However, the pure base was found to prevent death of rabbits suffering from cholera when given in an early stage (*i.e.* one hour before infection). The drug had no beneficial effect after the onset of diarrhoea (Panse and Nayak, 1971).

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## BRASSICA (Cruciferae)

*B. OLERACEA* Linn.

Eng. — Cabbage, cauliflower
Guj. — Pangoli
Hind. — Gobhi
Kan. — Kosugadde
Mar. — Knolkhol
Tam. — Koshipoo
Tel. — Kosuguddae

**Habitat :** Cultivated all over India.

**Parts used :** Leaves.

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**Ayurvedic description :** This is an exotic plant consumed as a vegetable and is named *Gobhi* in Hindi. Hence, the classical Indian medicine has made no mention of it. However, more recent works on indigenous drugs by Ayurvedic scholars, like the *Nighantu Aadarsha*, (Vaidya, 1968) have given it the Sanskrit name *Dalamaalineee* and described its properties as below :

*Rasa* — *Madhura*
*Veerya* — *Ushna*
*Vipaaka* — *Madhura*

Aadarshanighantu has described its actions as *mootrala*, *mridurechaka*, *paachaka*, and *krimighna*.

**Medicinal properties and uses :** Leaf extracts are used in gastric disorders, cardiac irregularities, constipation, chronic cough, bronchial asthma, biliousness, fever, urinary discharges, piles and warts (Nadkarni, 1954). It is also applied on blistered surface to promote a free discharge (Singh *et al.*, 1962).

**Pharmacology* :** The fresh juice of the plant (*B. oleracea* var. *capitata*) significantly prevented experimental peptic ulceration in guineapigs and this action was directly related to increase in gastric mucin. Experimental ulcers were produced in guinea-pigs by histamine hydrochloride (100 mg./kg.) and phenylbutazone (200 mg./kg.). The experimental ulcers healed completely within 120 hours. It is suggested that a possible mechanism of action could be through the presence of mucin-like substances in the juice (Singh *et al.*, 1962).

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Vaidya, B.G. 1968. Nighantu Aadarsha, Chowkhamba Vidya Bhavan, Varanasi, p. 73.

## BRYOPHYLLUM (Crassulaceae)

*B. CALYCINUM* Salisb. (Syn. *Kalanchoe pinnata* (Lamk.) Pers.)

Ben. — Koppata
Hind. — Zakhmhaiyat
Mar. — Ghayamari
Tam. — Ranakalli
Tel. — Simajamuda

*No report available on other aspects

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**Habitat :** Grows throughout hot and moist parts of India; common in Bengal.

**Parts used :** Leaves.

**Medicinal properties and uses :** Leaves are bitter and are also used as an application to bruises, wounds, boils and bites of insects (Chopra *et al.*, 1956).

**Chemistry :** The unsaponifiable matter of the petroleum ether extract of the leaves on column chromatography followed by I.R. and G.L.C. analysis revealed the presence of n-alkanes ($C_{25}$-$C_{35}$), n-primary alcohols ($C_{27}$-$C_{34}$), triterpenes (α and β amyrins), β-sitosterol and unidentified sterols. Fumaric acid, p-hydroxy-benzoic acid, p-hydroxy cinnamic acid, 4-hydroxy-3 methoxy cinnamic acid, syringic acid, quercetin, kaempferol and an unknown flavonoid were isolated from ether extract and identified by chromatographic studies, U.V. and I.R. analysis. The structure of the unknown flavonoid was elucidated as 3, 8-dimethoxy, 4′, 5, 7-trihydroxy flavone by mass spectra, N.M.R. and U.V. analysis. Quercetin-3-diarabinoside, kaempferol-3-monoglucoside and a small amount of an yellow crystalline compound were isolated from ethyl acetate extract (Gaind and Gupta, 1969, 1971).

On detailed study, the petroleum ether extract of the leaves was found to contain an alkane fraction ($C_{25}$-$C_{35}$) with $C_{31}$ (n-hentriacontane) and $C_{33}$ (n-tritriacontane) predominating. Alkanol fraction consisted of $C_{26}$-$C_{34}$. The triterpene fraction was shown to be α-amyrin and β-amyrin and sterol fraction consisted of sitosterol (Gaind and Gupta, 1972*a*).

Fumaric acid has been isolated from the ether extract of defatted leaves. A yellow crystalline solid (m.p. 284°) was obtained after treating the residue with methanol. It was purified by repeated sublimation to white needles, m.p. 287°, $C_4H_4O_4$. The I.R. spectrum and mixed melting point with authentic specimen confirmed the identity of the sample as fumaric acid (Gaind and Gupta, 1972*b*).

**Pharmacology :** Ether and ethyl acetate extracts of defatted leaves were found to possess antibacterial activity against a variety of microorganisms (Gaind and Gupta, 1969). Bryophyllin, isolated from the leaves of the plant was found very effective against a wide range of both gram-positive and gram-negative bacteria (Mehta and Bhat, 1952).

Crude powder and the decoction of the whole plant *Kalanchoe floribunda* was found lethal to sheep in an oral dose of $3^{-5}$ g/kg. The symptoms produced were salivation, lacrimation, depression, respiratory congestion with gasping and death within 2-3 hours due to respiratory failure. The symptoms were similar to those found in

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cyanide poisoning. A combination of sodium thiosulphate, sodium nitrite and atropine was found to be effective in combating the toxic effects of the plant (Singh *et al.*, 1972).

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Singh, R.C.P., Uppal, R.P. and Ahmad, A. 1972. Toxicological investigation of *Kalanchoe floribunda* in sheep. **Indian J Pharmac 4,** 137.

## BUDDLEIA (Loganiaceae)

*B. ASIATICA* Lour.

**Habitat :** Sub-Himalayan tracts from Indus eastwards, up to 1330 m., common in Bengal, south India.

**Parts used :** Flowers.

**Medicinal properties and uses :** Used for skin complaints and as abortifacient (Chopra *et al.*, 1956).

*B. MADAGASCARIENSIS* Lam.

**Habitat :** Ornamental garden plant. Large rambling evergreen shrub with densely tomentose branches and long leaves with yellow flowers in large terminal panicles.

**Parts used :** Leaves.

**Chemistry :** Quercetin and linarin (acacetin-7-rutinoside) were isolated from the ethanolic extract of the flowers of *B. asiatica.* The ethanol extract after dilution with

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water was extracted with ether and the residue dissolved in methanol. The methanol solution on concentration gave a yellow crystalline product identical with quercetin, m.p. 313-315°. It formed an acetate, m.p. 198° and methyl ether, m.p. 152-3°. From the aqueous solution could be isolated a flavone glycoside, having m.p. 272-4°. The identity of the glycoside was established as linarin (Sharma *et al.*, 1963).

From the leaves of *B. madagascariensis*, one alkaloid was isolated as reineckate, m.p 138-140° (decomp.). Two phytosterols and one hydrocarbon were also isolated and characterised. The hydrocarbon $C_{63}H_{126}$, m.p. 44-45° was obtained from the unsaponifiable matter of petroleum ether extract on column chromatography. Phytosterol *A*, $C_{30}H_{52}O$ and phytosterol B, $C_{20}H_{34}O$, m.p. 145-147° were obtained from the susbsequent fractions. From the aqueous extract of the leaf, three sugars were identified as rhamnose, sucrose and galactose (Baveja and Singla, 1969).

**Pharmacology :** The alcoholic extracts of the aerial parts of *B. madagascariensis* and *B. paniculata* were found to have CNS depressant activity in mice. Both these extracts produced hypothermia in mice (Bhakuni *et al.*, 1969).

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## BUPLEURUM (Umbelliferae)

*B. FALCATUM* Linn.

Punj. — Kalizewar, sipil

**Habitat :** Grows wild in Himalayas from Kashmir to Bhutan at 1000-4000 m.

**Parts used :** Roots and fruits,

**Medicinal properties and uses :** The roots in combination with other drugs are prescribed in liver disorders and as a diaphoretic (Chopra *et al.*, 1956). Its

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*Bupleurum jucundum*



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*Bupleurum falcatum*



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fruits are used as substitutes for *Carum carvi* fruits in commercial caraway samples in India.

**Pharmacognosy :** Pharmacognostical characters of the fruit have been studied to distinguish it from *Carum carvi* for which it is commonly substituted.

Macroscopical characters : The ripe fruits occur either as entire cremocarps or separated mericarps with the pedicels attached or detached. In between the prominent ridges, several fine striations are present that denote, the position of the vittae.

Microscopical characters : A transection through the middle region of the mericarp is circular with wavy outline. The epicarp has a striated cuticle and ranunculaceous type of stomata are observed. Abundant prism-shaped crystals of calcium oxalate are seen scattered in the cells of testa region. The cells of the grooved endosperm are rectangular to polygonal in shape and contain fixed oil, aleurone grains and prism-shaped calcium oxalate crystals (Dutt *et al.*, 1973).

Pharmacognostic studies have also been carried out on the root, stem and leaves of *B. falcatum* and *B. jucundum*. The former is a small, glabrous herb with entire grass-like simple leaves. The leaves of *B. jucundum* are slightly bigger in size. The roots of both species in transection show normal dicotyledonous structure. The xylem rays are broad which segregate the stele into 5-6 separate parts. There is no meristematisation of either the xylem parenchyma or the cells of xylem rays so that there is no formation of circular strands surrounded by cambium and secondory phloem. Secretory canals are few in number and small in size. The root of *B. jucundum* does not show any tendency for splitting.

The stems of both the species show almost a circular outline. Collenchymatous patches are present at regular intervals and in between are seen chlorenchyma cells. The vascular tissue is connected by patches of xylem fibres resulting in a circular shape. Pith occupies the central portion of the stem.

The leaf of *B. falcatum* is isobilateral while that of *B. jucundum* is dorsiventral. The midrib of both the species show bulge on the lower side. Small patches of collenchyma are seen both above and below and a small vascular bundle is present in the centre. Stomata are present on both the surfaces and are of anisocytic type.

Pharmacognostic constants of the leaves such as palisade ratio, stomatal index, stomatal number, vein-islet and veinlet termination number have also been determined. Preliminary phytochemical studies, fluorescence characteristics and ash values of all the plant parts have been determined (Raina, 1974).

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## BUTEA (Papilionaceae)

*B. FRONDOSA* Koen. ex Roxb. (Syn. *B. monosperma* (Lam.) Kuntze)

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Palas | Kon. and Mar. | — | Palash |
| Eng. | — | Bastard teak | Mal. | — | Pilacham |
| Guj. | — | Khakara | Tam. | — | Murukamaram, palashamaram |
| Hind. | — | Palas, tesu | | | |
| Kan. | — | Muttugamara | Tel. | — | Paladulu |

Commonly known as the 'flame of the forest'.

**Habitat :** Mountainous districts of India extending on the north-west to Himalayas as far as Jhelum and common all over Bengal, southern India and Burma.

**Parts used :** Gum, seeds, flowers, bark and leaves.

**Ayurvedic description**

| | | |
|---|---|---|
| Sanskrit : | *Palaasha* | |
| Synonyms : | *Kinshuka, parna, raktapushpa, kshaarashershta, krishnavrinta, tiktabeejaka, triparnas, vaatapotha, brahmavriksha, samidwara* | |
| Properties : | *Rasa* | — *Tikta, katu, kashaaya* |
| Seeds : | *Guna* | — *Snigdha, sara* |
| | *Veerya* | — *Ushna* |
| | *Vipaaka* | — *Katu* |
| Actions/Uses : | *Agnideepani, shukravardhani, graahi, trishnaashamani, bhedhana, krimighna, sthambhana, garbhaadhaananivaarana* | |
| Seeds : | *Bhedana, krimighna* | |
| Flowers : | *Trishnashamani, sthambhana, mootrala* | |
| Fruits : | *Pramehaghna, arshaghna, krimihara, kushtaghna, udararogaghna* | |
| Alkali (*Kshaara*) : | *Bhedana, anulomana* | |

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**Medicinal properties and uses :** Gum is astringent; seeds are laxative and anthelmintic; leaves and flowers are tonic, aphrodisiac and diuretic (Chopra *et al.*, 1956; Nadkarni, 1954).

*B. PARVIFLORA* Roxb.

**Habitat :** Climbing shrub, found throughout India, distinguished by very small flowers.

**Parts used :** Flowers, seeds.

**Medicinal properties and uses :** Gum of the flower is used in colic and hysteria.

*B. SUPERBA* Roxb.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Kimsuka, palaslata | Sans. | — | Lataa palaassha |
| Hind. | — | Kesu, palaslata | Tam. | — | Kodai-murukkan |
| Mar. | — | Palas-wel | | | |

**Parts used :** Seeds and flowers

**Medicinal properties and uses :** Used as sedative and anthelmintic. It is a remedy for the poisonous bites of animals, its root being used in combination with several other drugs; flowers yield a yellow dye (Nadkarni, 1954).

**Chemistry :** A detailed analysis of the flavonoid components of the flowers has been carried out. Petroleum ether extraction removed waxy matter containing steroids. The alcoholic extract yielded flavonoids in pure form. Besides free Butein (0·37 per cent) and Butin (0·04 per cent), the major compound was Butrin (1·5 per cent) the constitution of which has been established (Murti and Seshadri, 1940; Rao and Seshadri, 1941).

Later studies have shown that the flowers contained only isobutrin which slowly underwent change into butrin on storage and the change was fast with sun-dried flowers with the result that in the stored flowers butrin was the major component and isobutrin the minor (Puri and Seshadri, 1953).

The root of *B. monosperma* was found to contain glucose, glycine, a glycoside and an aromatic the hydroxy compound (Tandon *et al.*, 1969).

A reinvestigation of the flowers of *B. monosperma* revealed the presence of 7 flavonoid glucosides, two of them being butrin and isobutrin isolated earlier from the plant. Three of the glucosides were identified as coreopsin, isocoreopsin and sulphurein respectively. Two other new ones were assigned mono-spermoside and isomonosper-

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moside structures. All the seven are structurally and biogenetically related, three being glucosides of butin, three of butein and the last sulphurein being aurone glucoside (Gupta *et al.*, 1970).

Tetramers of leucocyanidin having —C-C and —C-O-C-linkages were isolated from the gum and bark of *B. monosperma*. The molecular size of the procyanidns, were determined by a study of more stable derivatives, *viz.* acetate, methyl ethers and methyl ether acetates. The procyanidins have no catechin unit and their methyl ethers do not consume any periodate. The NMR spectra of the methyl ether acetate indicated the ratio of acetoxyl to methoxyl protons to be 1 : 4 and these suppored the structural assignment (Seshadri and Trikha, 1971).

A yellow coloured oil was obtained from the seeds of *B. parviflora*. The yield was 16 per cent and it contained glycerides of palmitic (20·89 per cent) stearic, (15·89 per cent), lignoceric (5·55 per cent), oleic (40·62 per cent) and linoleic (17·05 per cent) acids. The unsaponifiable matter of the oil contained β-sitosterol (Garg, 1971).

**Pharmacology :** The alcoholic extract of the seeds of *Butea frondosa*, on oral administration, was found to have antifertility activity in female mice and rats. The aqueous and chloroform extracts were found ineffective. The alcoholic extract partially inhibited ovulation and significantly suppressed the decidua cell reaction in rats. The $LD_{50}$ in mice was found to be 7·5 g./kg. (Razdan *et al.*, 1969; Khanna and Chaudhury, 1968). Hot petroleum ether extract of the seeds showed significant antifertility effect in female rats (Khanna *et al.*, 1966).

The alcoholic extract of the seeds of *B. monosperma* was fractionated by column chromatography. The various fractions were tested for anti-implantation activity in albino rats, at different doses. None of these fractions revealed any encouraging anti-implantation activity (Garg *et al.*, 1969).

A crystalline fraction composed of the glycosides butrin and palasitrin, isolated from the alcoholic extract of the petals of *B. frondosa* reduced the number of implants in the mated rats. It did not inhibit ovulation induced by copper acetate in female rabbits (Kapila *et al.*, 1970).

A good deal of controversy exists regarding the anti-oestrogenic effect of the alcoholic extract of the flower petals of *B. frondosa*. Laumas and Uniyal (1966) reported anti-oestrogenic effect of the extract at a dose level of 3·2 mg./kg. body weight per day. However, no activity could be demonstrated at a dose level of 1·6 mg./kg. per day. Razdan *et al.* (1970) reported that the alcoholic extracts of flower petals and seeds of *B. frondosa* did not significantly alter the effect of oestrogen in the dose range of 10-100 mg./kg./day (petal extract given subcutaneously) and 100-1500 mg./kg./day (seed extract given orally) in mice.

Palasonin, an active principle isolated from *B. frondosa* seeds and its piperzaine salt exhibited good anthelmintic activity *in vitro* on *Ascaris lumbricoides* and

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*Butea monosperma*

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*Callicarpa macrophylla*

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*in vivo* on *Toxicara canis*, comparing favourably with piperazine and santonin (Kaleysa and Kurup, 1968).

Chronic administration of *B. frondosa* by oral route for 2 months produced marked nephrotoxicity and anaemia in rats, dogs and rabbits. Congestion in liver, lungs and spleen was also observed. Stomach showed gross dilation and chronic inflammation (Sachdev *et al.*, 1965).

Oil obtained from the seeds of *B. superba*, in a dose of 120 mg./kg., showed a marked and prolonged fall in the blood pressure with no effect on respiration. The fall in blood pressure could not be blocked by pretreatment with atropine sulphate or mepyramine maleate (2 mg./kg.), nor was it modified in the presence of hexamethonium bromide (1 mg./kg.) or nicotine bitartrate (20 mcg./kg.).

The oil in a dose of 80-100 mg./kg. showed inhibition of the ventricular movement. The oil also reduced the amplitude of contraction of isolated frog heart and relaxed the rabbit duodenum. Mice tolerated doses, up to 1·5 mg./kg. intraperitoneally (Siddiqui and Inamdar, 1963).

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## CACCINIA (Boraginaceae)

*C. GLAUCA* Savi

Local name : Gaozaban

**Habitat :** Native of Baluchistan.

**Parts used :** Leaves.

**Medicinal properties and uses :** It is an alterative, tonic, diuretic, and demulcent; used in syphilis and rheumatism (Chopra *et al.*, 1956; Nadkarni, 1954).

**Chemistry :** The isolation of rutin and an acid saponin mixture from the leaves was first reported (Parthasarthy and Seshadri, 1964). By using butanol method, the acid saponin mixture could be obtained in greater yield. After its hydrolysis with sulphuric acid, glucose and rhamnose were identified in the water soluble part of the hydrolysate. The aglycone obtained in the form of ester was given the name caccigenin, $C_{31}H_{50}O_6$ m.p. 273-275° (Ayengar and Rangaswami, 1966).

**Pharmacology :** A crude glucoside caccinin and an aglucone caccinetin, isolated from the plant were found to exhibit diuretic action on conscious and anaesthetized rats as well as anaesthetized dogs, both on oral and parenteral administration in a dose of 50 mg./kg. body weight. The diuretic activity of these compounds appeared to be due to increased glomerular filtration, as in case of xanthines. At this dose no other activity could be found. At a much higher dose (200 mg./kg. body weight), a fall in the blood pressure of rats and dogs was observed. A positive inotropic action was noted on the cat papillary muscle preparation (Arora and Arora, 1962).

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## CAESALPINIA (Caesalpiniaceae)

*C. CRISTA* Linn. (Syn. *C. bonducella* Flem., *C. bonduc* (Linn.) Roxb.)

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Nata-karanja | Mal. | — | Kazanchik-kuru |
| Hind. | — | Kat-karamj | Mar. | — | Sagar-gota |
| Kon. | — | Gajago | Tam. | — | Kazachchikaai |
| | | | Tel. | — | Gacacha-kaya |

**Habitat :** Occurs throughout the hotter parts of India upto a height of 830 m., common in Bengal and south India.

**Parts used :** Seeds, leaves and bark.

**Ayurvedic description**

Sanskrit : *Kuberaaksha*

Synonyms : *Pooteekaranja, prakeerna (prakeerya), kantakikaranja, vitapakaranja, pootika, lataakaranja*

Properties : *Rasa* — *Katu, tikta*
*Guna* — *Laghu, rooksha, teekshna*
*Veerya* — *Ushna*
*Vipaaka* — *Katu*

Actions/Uses : *Shramsana, bhedana, shothaghna, vranaropana, krimighna, virechanee, vedanaasthaapana, yakritrogaghna, pleeharogaghna, shwaasahara, mootrala, raktashodhaka*

**Medicinal properties and uses :** Seeds are antiperiodic, antipyretic, tonic, febrifuge, given in asthma and snake-bite. Tender leaves are used in disorders of the liver. Leaves and seeds are used externally for dispersing inflammatory swellings. Leaves and bark are emmenagogue, febrifuge and anthelmintic. Oil from seeds is an emollient,

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used as embrocation to remove freckles from the face and to stop discharges from the ear (Chopra *et al.*, 1956; Nadkarni, 1954).

*C. DIGYNA* Rottl. (Syn. *C. oleosperma* Roxb.)

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Umul-kuchi | Mar. | — | Vakerichebhat |
| Hind. | — | Vakeri-mul | Tam. | — | Nuni-gatcha |
| | | | Tel. | — | Nooniglika |

**Habitat :** Occurs in eastern and western Peninsula, Assam, Bengal, Burma, eastern Himalayas, and Ceylon.

**Parts used :** Roots.

**Medicinal properties and uses :** Root is given internally in pthisis, as astringent and in scrofulous affections and diabetes (Nadkarni, 1954; Chopra *et al.*, 1956).

**Pharmacognosy :** The seeds of *C. crista* have been studied pharmacognostically. The seeds are globular, shiny and grey with thick testa. These are ex-albuminous. In a transection the seeds show a palisade layer composed of vertical, columnar and laterally close appressed cells. Thickenings are present on the walls of palisade cells which in tangential sections appear as 6-12 denticulate projections into the lumen of cells. The palisade layer is followed by a layer of bearer cells and thick zone of parenchymatous cells. Majority of the bearer cells in this species are I-T shaped, non-lignified and thick-walled. The structure of epidermal as well as mesophyll cells of the cotyledons with their contents also form very conspicuous feature. The powder of the seeds shows under the microscope, columnar palisade cells, bone-shaped thick walled cells, small roundish to polygonal bearer cells, starch grains etc. These characters in macerations and powder form are helpful in identifying the species.

Roots as well as the powder do not show any fluorescence when exposed to ultraviolet light. But the extract in 1 per cent NaOH solution, ethyl alcohol and solvent ether, emitted a light green fluorescence under ultraviolet light (Sharma and Singh, 1972).

**Chemistry :** A crystalline phenolic substance, provisionally named as vikerin $C_{15}H_{18}O_{10}$ was isolated from the roots of *C. digyna*. Its m.p. was 238°. On acetylation with acetic anhydride in pyridine or in the presence of fused Na-acetate, vakerin gave a penta-acetyl derivative having m.p. 205°. With diazomethane, it gave a dimethyl ether, m.p. 199°. The dimethyl ether on acetylation with acetic anhydride in presence of a drop of perchloric acid gave triacetyl vakerin dimethyl ether, m.p. 130° (Chaudhry *et al.*, 1954). Later its molecular formula has been corrected as $C_{14}H_{16}O_8$. It contained one methoxyl and 5 hydroxyl groups, out of which two were phenolic. The physical and chemical characteristics of vakerin were found to be identical with

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those of bergenin and the identity was further confirmed by IR spectra (Chaudhury, 1957).

**Pharmacology :** The powdered seeds of *C. bonducella* were found to have anti-estrogenic activity in mice and rabbits. Antifertility action of the seeds was noted in mice and rats (Bhide *et al.*, 1970).

The nuts of *C. bonducella* were found to have significant anti-diarrhoeal activity in mice. The effect of the drug could not be attributed to tannins as the nuts were found to be devoid of tannin (Iyengar and Pendse, 1965).

The alcoholic extracts of the root and stem of *C. bonducella* were found to have anti-viral activity against *Vaccinia virus* (Dhar *et al.*, 1968). The extract of the root of *C. sepiaria* showed anti-viral activity against both *Ranikhet disease virus* and *Vaccinia virus* (Bhakuni *et al.*, 1969).

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# CALNEDULA (Compositae)

*C. OFFICINALIS* Linn.

Punj. — Zergul

**Habitat :** Grows wild in Punjab, Sind and Peshawar. Cultivated in many parts of India as an ornamental plant.

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**Parts used :** Flowers and leaves

**Medicinal properties and uses :** It is an astringent and styptic. The whole plant is also useful in healing wounds. Leaves are resolvent and diaphoretic. Flowers are stimulant, antiseptic and emmenagogue (Chopra *et al.*, 1956; Nadkarni, 1954).

**Chemistry :** Chemical analysis of the leaves revealed the presence of 14.9 per cent ash, 3.04 per cent calcium and 6.45 per cent of tannins (Bose *et al.*, 1959).

**Pharmacology :** The aqueous extract, which has been found to contain both calcium and tannins showed a haemostatic action. It showed fibrin formation in 67 seconds. The alcoholic extract and tannin-free aqueous extract had very little effect (Bose *et al.*, 1959).

The alcoholic extract of the whole plant was found to have antiprotozoal activity against *Entamoeba histolytica* (Dhar *et al.*, 1968).

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## CALLICARPA (Verbenaceae)

*C. MACROPHYLLA* Vahl.

| | | | |
|---|---|---|---|
| Ben. | — Mathara | Mal. | — Chimpompil |
| Hind. | — Daya | Punj. | — Sumali |

**Habitat :** Found in upper Gangetic plain, Bengal, western Himalayas from Kashmir eastward upto 2,000 m. and in Assam.

**Parts used :** Leaves and root.

**Medicinal properties and uses :** Leaves are heated and applied to rheumatic joints. Oil from the root is aromatic and stomachic (Chopra *et al.*, 1956).

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**Chemistry*** : From the petroleum ether extract of the aerial parts of *C. macrophylla*, two new tetracyclic diterpenes were isolated *viz.* calliterpenone, $C_{20}H_{32}O_3$, m.p. 153-5°, calliterpenone monoacetate, $C_{22}H_{34}O_4$, m.p. 124°. Their structures and stereochemistry have been established from a careful analysis of their spectroscopic data and chemical evidences (Chatterjee *et al.*, 1972).

### Reference

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## CALOPHYLLUM (Guttiferae)

*C. APETALUM* Willd. (Syn. *C. wightianum* T. Anders)

Mal. — Cherupinnai
Mar. — Bobbi
Tam. — Shirupinnaimaram

**Habitat :** Western ghats of Bombay state and from Mysore to Travancore upto 330 m., banks of rivers and backwaters on west coast from north Kanara southwards.

**Parts used :** Resin, oil of seeds and dried seed kernels.

**Medicinal properties and uses :** Resin is antiphlogistic and anodyne. Oil of seeds is used in leprosy and cutaneous affections (Chopra *et al.*, 1956).

*C. INOPHYLLUM* Linn.

Ben. — Punnag
Eng. — Alexandrian laurel
Hind. — Surpan
Kan. — Surahonne
Kon. — Undee-phal
Mal. — Cherupuna
Mar. — Undag
Tam. — Pinnaimaram
Tel. — Pumagamu

**Habitat :** Ornamental tree found near the sea-coast throughout India, Orissa, south India and western Peninsula.

**Parts used :** Bark, seeds, leaves, bitter oil from the seeds and resin.

*No report available on other aspects.

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**Ayurvedic description**

Sanskrit : *Punnaaga*

Synonym : *Tunga*

Properties : *Rasa* — *Madhura, tikta*
*Guna* — *Laghu, rooksha*
*Veerya* — *Sheeta*
*Vipaaka* — *Madhura/katu*

Actions/Uses : *Sugandhi, snehana, sthambhana, vedanasthapana, vranaropana, mootrala.*

**Medicinal properties and uses :** Bark is astringent and its juice is purgative. The gum is emetic and purgative (Nadkarni, 1954).

*C. TOMENTOSUM T.* Anders (Syn. *C. elatum* Bedd.)

Mal. and Punj. — Kattupunna Tam. — Kattupinnai
Mar. — Nagani

**Habitat :** Found in western ghats, from north Kanara to Travancore, up to 1660 m.

**Parts used :** Seeds and gum.

**Medicinal properties and uses :** Gum is feebly astringent (Chopra *et al.*, 1956).

**Pharmacognosy :** The pharmacognostic studies of the stem bark have been carried out.

Macroscopic characters : The stem bark of *C. inophyllum* is curved with the outer surface characterised by the presence of numerous longitudinal and deep transverse fissures at fairly regular intervals with the result that the surface becomes divided into irregular areas which peel off easily and reveal the smooth reddish brown cortex. The outer surface of the bark is also characterised by the presence of lichens and sometimes mosses.

Microscopic characters : In transection, outer cork layer composed of 6-12 layers of cells is followed by cortex. In the cortex, numerous secretory ducts are scattered which contain gum and resin and these ducts are schizolysigenous in nature. Numerous calcium oxalate crystals and starch grains are also present. Cortical fibres are broadest at the middle and tapering at both ends. Phloem fibres have large lumen and thick walled pitted parenchymatous cells filled with granular masses are also present. Abundant chambered crystalliferous cells with prismatic crystals of calcium oxalate in the phloem region constitute a highly diagnostic character. The stem bark is also characterised by the absence of stone-cells (Chaudhuri, 1965).

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**Chemistry :** From the bark of *C. apetalum*, friedelin and a new acid named apetalic acid were isolated. The roots gave friedelin whereas the stem gave friedelin and β-amyrin and the wood yielded β-sitosterol and mesoinositol. Apetalic acid had m.p. 117°, molecular formula $C_{22}H_{28}O_6$ (Govindachari *et al.*, 1967*a*). The structure of apetalic acid has been confirmed by the synthesis of its degradation products. Apetalic acid on treatment with anhydrous aluminium chloride in benzene gave "lactone A" m.p. 113-114°. Treatment of the acid with hydroiodic acid gave stereo-isomeric "lactone B" m.p. 130°. Both isomers had molecular weight 304 and on methylation with methyl iodide and potassium carbonate led to the same methyl ether (Govindachari *et al.*, 1968*a*).

Mesuaxanthone B and a new xanthone, calophyllin B were isolated from the heart-wood of *C. inophyllum*. The hexane and hexane-acetone extracts gave a solid mixture of pigments which on chromatography over silica, yielded three yellow crystalline com-pounds, A,B, and C having m.p. 170°, 218° and 239° respectively. The acetone extract yielded pigments C and D. The pigment D, m.p. 290°, $C_{13}H_5(OH)_3O_2$, was identified as mesuaxanthone B by direct comparison with authentic specimen.

Compound B was named as calophyllin B and its structure was also found. Calophyllin B, m.p. 218-20°, $C_{18}H_{16}O_4$, formed a dimethyl ether and a diacetate revealing the presence of hydroxyl groups. The molecular formula was established as $C_{22}H_{20}O_6$ for the diacetate (Govindachari *et al.*, 1968*b*).

Apetalactone, m.p. 335-336° (decomp.), $C_{30}H_{50}O_3$, a new triterpene lactone was isolated from the leaves of *C. apetalum* and *C. tomentosum*. It was shown to be 4, 28-dihydroxy-3, 4-secofriedelan-3-oic acid lactone. The results showed that apetalactone was a tetracarbocyclic triterpene lactone having an angular hydroxymethyl group (Govindachari *et al.*, 1968*c*).

Friedelin and three new triterpenes of the friedelin group have been isolated from the leaves of *C. inophyllum*. The three new compounds canophyllal, canophyllol and canophyllic acid have been interrelated and their structures established (Govindachari *et al.*, 1967*b*).

The presence of two new crystalline lactones, tomentolide A and tomentolide B has been reported from *C. tomentosum*. Tomentolide A appeared to be related isomer of inophyllolide. *C. apetalum* yielded another new lactone, apetalolide and β-D-glucoside of β-sitosterol (Nigam and Mitra, 1968).

The androecium of the flowers of *C. inophyllum* had myricetin-7 glucoside, along-with small quantities of free myricetin and quercetin (Subramanian and Nair, 1971).

Earlier work on the seed and seed oil of *C. inophyllum* had led to the isolation of 3 compounds : calophyllolide, calophyllic acid and inophyllolide. They are 4-phenyl coumarin derivatives and are included in the new group of neoflavonoids. Later Mitra (1957) reported the isolation of inophyllic acid which is given the constitution of a

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benzene derivative with a long side chain ending in carboxylic acid. From the unripe fruits was isolated a new compound ponnalide (Adinarayana and Seshadri, 1965). Its correct constitution was established as a 4-phenyl coumarin with a dimethyl chromene ring between 5-6 positions, a hydroxyl at 7 position and C-5 ketone (∝-methyl butyryl) at the 8 position (Murti *et al.*, 1972). Further, yet another 4-phenyl coumarin calaustralin, was isolated from the seed oil of *C. inophyllum* and its constitution established (Bhushan *et al.*, 1975).

**Pharmacology :** Calophyllolide produced a slight bradycardia in a dose of 10 mcg./ml. in isolated perfused rabbit heart. It decreased the amplitude of contraction with no effect on rhythm, but increased the coronary flow. It was found to be as effective as quinidine in suppressing ventricular ectopic tachycardia resulting from acute myocardial infarction in dogs. It possessed vasoconstrictor action on peripheral vessels in isolated rabbit ear perfusion. The anticoagulant activity of calophyllolide was found to be intermediary in potency between dicoumarol and tromexan. The activity was evaluated in rabbits by determining the prothrombin time and coagulation valency in a dose of 50 mg./kg. orally (Arora *et al.*, 1962).

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## CALOTROPIS (Asclepiadaceae)

*C. GIGANTEA* R. Br. (Syn. *Asclepias gigantea* Willd.)

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Akanda | Mal. | — | Erikka |
| Eng. | — | Swallow-wort, mudar | Mar. | — | Ruvi |
| Guj. | — | Akado | Tam. | — | Aerukku |
| Hind. | — | Madar | Tel. | — | Mandaramu |
| Kan. | — | Ekka | | | |

**Habitat :** An erect, spreading perennial shrub with milky juice. Grows in waste lands in lower Bengal, Himalayas, Punjab, Assam, south India and Ceylon.

**Parts used :** Root, root-bark, leaves, juice of the plant and flowers.

**Ayurvedic description***

Sanskrit : *Arka, alarka*

Synonyms : *Sooryaahwa, sadaapushpi, sooryapushpaka, aspota, jambala, ksheeree, ksheeraparna, vikeerana, kshataksheeree, dugdhaanika, pushpee, tanuphala*

Common general properties :

| | | |
|---|---|---|
| *Rasa* | — | *Katu, tikta, madhura* |
| *Guna* | — | *Sara, snigdha, laghu* |
| *Veerya* | — | *Ushna* |
| *Vipaaka* | — | *Katu* |

Actions/Uses

General : *Krimighna, kushtaghna, vranaghna, arshoghna, gulmaghna, vishahara*

Arkapushpa : *Madhura, tikta, sangraahi, kushtaghna, krimighna, arshoghna, raktapitta-shamana, shophaghna, gulmaghna*

Alarkakusuma : *Laghu, deepana, paachana, arochakashamana, praseekashamana, arshoghna, shwaasahara, kaasahara*

Arkaksheera : *Sara, snigdha, laghu, katu, gulmaghna, kushtaghna, udararogaghna, virekashreshta*

**Note* : Calotropis with red flower is known as *Arka* and the one with white flower, as *Alarka*. Both the varieties are said to share several properties in commom and also actions/indications in general.

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**Medicinal properties and uses :** This drug acts like digitalis on heart. The taste of the root barks of both varieties is mucilaginous and bitter and the odour is peculiar. Flowers are digestive, stomachic and tonic. Milky juice is a violent purgative and gastro-intestinal irritant. All parts of the plant have alterative properties when taken in small doses (Nadkarni, 1954).

*C. PROCERA* R. Br.

| | | | |
|---|---|---|---|
| Ben. | — Akanda | Mar. | — Mandara |
| Hind. | — Madar | Punj. | — Shakar-al-lighal |
| | | Tam. | — Vellaerukku |

**Habitat :** Found in north, western and central India from Sind, and in Punjab, Bengal, Bihar and Bombay and in the drier climate of the Deccan. This is the smaller white flowered variety.

**Parts used :** Root, root-bark, leaves, juice and flowers.

**Medicinal properties and uses :** Flowers have detergent properties (Nadkarni, 1954).

**Pharmacognosy :** The macroscopic and microscopic characters of leaves of *C. gigantea* have been carried out.

Macroscopic characters : The leaves are thick, glaucous, clothed beneath with fine cottony tomentum.

Microscopic characters : The epidermis in lamina is followed by three layers of closely packed palisade cells filled with chloroplasts. Multicellular, thin walled trichomes are distributed throughout the leaf. Half stomata are found in the lower epidermis besides the rubiaceous type of stomata. Epidermal cells contain starch grains, fats and oils in parenchyma but tannin is absent.

The powder is greyish to yellowish green, with pungent odour. Under the microscope, groups of epidermal cells, stomata, portions of vascular elements with spiral vessels are observed (Chaudhuri, 1961).

The quantitative values, physical constant and fluorescence characters of the leaves of the two species *C. procera* and *C. gigantea* have been studied. Both the species are very much similar in their physical constants but are different in case of fluorescence characters (Table I) which are useful in the identification of the two species (Gupta *et al.*, 1971).

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**Table I. Fluorescence characteristics of leaf powder of *C. procera* and *C. gigantea* under UV light.**

| | *C. procera* | *C. gigantea* |
|---|---|---|
| 1. Dry powder | grey | greenish blue |
| 2. Powder treated with nitrocellulose | dirty orange | orange |
| 3. Powder treated with IN methanolic NaOH | yellowish green | brown |
| 4. Powder treated with IN methanolic NaOH and mounted in nitrocellulose | pale green | yellowish-brown |

**Chemistry :** Chemical constituents of *C. gigantea* have been studied. The leaves contain an active principle mudarine. Besides this, a yellow bitter acid and resin were also found. The leaves, in addition, contained three glycosides *viz.* calotropin uscharin and calotoxin (Chaudhuri, 1971).

A powerful bacteriolytic agent capable of lysing *Micrococcus lysodeikticus* had been found to be present in the latex of *C. procera*. The enzyme had maximum activity at pH 5-5·4 at 45°. The action was potentiated by versene and hexametaphosphate and inhibited by heavy metals. The inhibition by $^{2+}$ could be arrested by versene and cysteine. The partial purification of enzyme by displacement adsorption on calcium phosphate gel and precipitation with hexa-metaphosphate has also been carried out (Shukla and Krishnamurti, 1961).

Asclepin, isolated from *Calotropis* sps. was found to be 3-0-acetyl-calotropin by various chemical and physical tests. NMR spectra of all calotropin glycosides were studied and revised structures have been proposed (Singh and Rastogi, 1972).

**Pharmacology :** The aqueous and the alcoholic extracts of the roots of *C. procera* in a dose of 0·2 ml. produced slight depression followed by stimulation of the rate and force of myocardial contraction on isolated frog's heart. Same action was also observed in isolated rabbit's heart in a dose of 0·2 ml./100 g. body weight. At the same dose, the extracts showed marked vasoconstriction in blood vessels of frog and hind limbs of the rat. Both the extracts showed persistent rise in blood pressure of dog, which could not be altered by any sympathetic drug. A stimulating action on the force and frequency of respiration was observed. The extracts caused marked contractions of rabbit's duodenum, rat's ileum and uterine horn of virgin rat. The action could be blocked by papaverine hydrochloride. The aqueous extract had a mild diuretic effect in male albino rats. Both the extracts showed marked vermicidal action on earthworms. The extracts were found to be non-toxic (Derasari and Shah, 1965).

The crude latex of *C. procera* and its protein fraction were found to possess high fibrinolytic and anti-coagulant activity both in rabbit and human plasma (Srivastava *et al.*, 1962).

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The milky juice of *C. gigantea* exhibited marked stimulant action on the spontaneous activity of the isolated nongravid rat uterus (Dhawan and Saxena, 1958).

The alcoholic extracts of the root and leaves of *C. gigantea* and *C. procera* were found to have anti-cancer activity against human epidermal carcinoma of the nasopharynx in tissue culture (Dhar *et al.*, 1968; Bhakuni *et al.*, 1969).

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# CANNABIS (Urticaceae)

*C. INDICA* Linn. (Syn. *C. sativa* Linn.)

| | | | |
|---|---|---|---|
| Ben. | — Bhang, ganja | Mar. | — Bhang |
| Guj. | — Ganja | Mal. | — Kancha |
| Eng. | — Indian Hemp | Tam. | — Kanja |
| Hind. | — Ganja, charas | Tel. | — Ganjayi |
| Kan. and Kon. | — Bhangi | | |

**Habitat :** The pistillate plant is a native of Persia, western and central Asia, now cultivated all over India. Found wild on the eastern Himalayas from Kashmir to east of Assam. The plant is a nitrophile, blooming well in nitrogenous wastes and near

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human habitation. The life cycle of the plant is short, 4-6 months, seedlings sprout in rains, flowering and fruiting is completed by late September (Mehra, 1972).

**Parts used :** Dried flowering or fruiting tops of the pistillate plant. Leaves, seeds, and resinous exudation of 3 varieties of *cannabis viz. ganja, bhang* and *charas* are best for medical use (Nadkarni, 1954).

**Ayurvedic description**

Sanskrit : *Bhanga*

Synonyms : *Ganja, ganjaka, matulaani, bhangika, jaya, deergha, vichchrita, varshika, maadani, uttejaka, vaajikara, sadahaka, siddhipatra.*

Properties :

| | | |
|---|---|---|
| *Rasa* | — | *Tikta* |
| *Guna* | — | *Teekshna, laghu* |
| *Veerya* | — | *Ushna* |
| *Vipaaka* | — | *Katu* |

Actions/Uses : *Graahi, vyavaayi, vikaashi, karshana, deepani, paachana, ruchya, madakara.*

**Medicinal properties and uses** : All parts of the plant are found to be intoxicating, stomachic, antispasmodic, analgesic, stimulant, aphrodisiac and sedative. In large doses it causes mental exaltation, intoxication, a sense of double consciousness and finally a loss of memory (Nadkarni, 1954).

**Pharmacognosy :** It is important to distinguish the male plants from the female because the chemical compounds responsible for the euphoric effect of cannabis are present in the resin covering the female flowers and adjacent leaves. The leaves of the female plants are longer than the leaves of the male plant.

Microscopic characters : The stem is longitudinally furrowed, pubescent, light green when young and becomes slightly purplish when mature. Leaves are palmately compound while the leaflets are linear-lanceolate with serrate margin. Bracts are foliaceous. The ovary is one chambered and contains a single compylotropous ovule. The odour is agreeable and aromatic and the taste pungent.

Macroscopic characters : The stem has both non-glandular and glandular type of trichomes. Stele has a continuous ring of vascular bundles. Laticiferous vessels with yellowish-brown contents are present in the pith. The female plants have more secretory cells in the phloem region.

Leaf has numerous glandular trichomes. In the midrib the secretory cells in the phloem region are filled with resin. Rosette crystals of calcium oxalete are clearly

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visible in the parenchyma. Abundant starch grains are present in the stem and leaf.

A transection of the flower shows six lignified vascular bundles in the parianth. The various narcotic preparations have also been mentioned (Kapoor, 1972).

The characteristic features of male and female inflorescences have been described. There are three types of glands *viz.*, (*i*) unicellular discoid glands occurring on lower leaf surface, bracts and axes, (*ii*) slightly raised disc shaped glandular hair common on bracts and (*iii*) capitate glands supported by stalks.

Juvenile parts of carpellate and staminate inflorescence are rich in glandular trichomes. Two types have been recognised *viz.* (*i*) short conic hairs with expanded base containing a large cystolith, on the upper surface of young leaves and (*ii*) long hairs of various sizes with silicified walls on leaf and axes. Various pharmaceutical preparations available in India have also been described (Mehra, 1972).

**Chemistry :** The chemical constituents of *Cannabis* have been studied by various techniques *viz.* paper chromatography, thin-layer chromatography, gas-liquid chromatography, spectrophotometric investigations etc. The following constituents have been found to be present :

Cannabinol : 6,6, 9-trimethyl-3-pentyl 6H-dibenzene (b, d)— pyran-1-o1 which is pharmacologically inactive. Tetrahydrocannabinol : 6a, 7, 8, 10a-tetrahydro-6, 6, 9-trimethyl-3-pentyl-6H-dibenzo (b,d)-pyran-1-o1; which is euphorically active. Cannabidiol; which has no pharmacological activity. Cannabidiolic acid; which has sedative and antibacterial activities. Cannbigerol in which no activity is reported. A number of qualitative tests for the identification of cannabinoids have been given (Sharma *et al.*, 1972).

The resin content in crude charas, leaves and stem of *C. indica* was found to be 29·23, 7·25 and 3·25 per cent respectively (Bose *et al.*, 1963*a*).

Analysis of some samples from Madhya Pradesh, West Bengal, Orissa etc. have shown that they contain mainly tetrahydrocannabinol (THC) and cannabinol (CBN) and varying amounts of cannabidiol (CBD) (Podder and Ghosh, 1974).

The dried flowering tops of *Cannabis sativa* from eight different regions of northern India were analysed qualitatively. The content of CBN, CBD and THC in these samples was also determined. The Shillong cannabis sample was found to be rich in THC and had no CBD. A Kud sample showed only traces of THC and CBN but was rich in CBD and another compound which was tentatively regarded as cannabidivarin (propyl analogue of CBD). The fresh samples were shown to contain neutral cannabinoids as their respective acids (Krishnamurty and Kaushal, 1974).

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**Pharmacology :** The pure resin produced an inhibitory action on the respiratory movements of dogs. It relaxed the plain muscles of rabbit intestine and rat uterus and antagonised the spasmogenic effect of carbachol, histamine, barium chloride and pitocin by direct musculotropic action (Bose *et al.*, 1963*a*). The resin produced typical behavioural changes in dogs characterised by initial excitement, followed by depression of both. On recovery, an increased excitability of neurones was observed. The initial excitement produced by the drug was found partly due to the stimulant action on certain areas of CNS as revealed by EEG studies (Bose *et al.*, 1964*a*). The alcoholic extract and the resin increased hexobarbital sleeping time, enhanced the action of reserpine and antagonised the action of 5-HT in rats. It also depressed the tissue respiration of rat brain (Bose *et al.*, 1963*b*). The resin has been found to increase the 5-HT content of rat brain and antagonize the peripheral actions of 5-HT, to which the psychotomimetic effect of the resin has been attributed. The drug has been found to interfere with the peripheral responses to acetylcholine, adrenaline and noradrenaline (Bose *et al.*, 1964*b*).

Purified extract of *C. indica* caused elevation of blood glucose with decrease of liver glycogen in albino rats. Muscle glycogen was not affected (Soni and Gupta, 1970). Cannabinol, isolated from the alakali-insoluble fraction of the resin, was found to produce deep anaesthesia in dogs at a dose of 40 mg./kg. body weight. The drug was well tolerated by emaciated dogs suffering from hepatitis. The skeletal muscle tone rapidly disappeared leaving the dog completely flaccid. The palpebral, corneal and pedal reflexes were also depressed. The respiration rate also decreased. The alcoholic solution alone did not show any anaesthetic effect but there was imbalance and ataxia (Singh, 1968).

Studies on the physiologically active fractions of *C. sativa* revealed that the total extract and alkali-insoluble fraction possessed narcotic properties as evidenced by production of ataxia in cats. The alkali-soluble fraction did not possess any activity. The activity of alkali-insoluble fraction was found greater than that of homotetrahydrocannabinol, which indicated that the fraction contains some optical isomers of tetrahydro-cannabinol which are more active (Bose and Mukerji, 1945).

Comparative studies were carried out to see the behavioural effect of *C. sativa*, chlorpromazine , and their combination on conditional avoidance response (CAR) in rats. Both these drugs individually and in combinations blocked CAR. *C. sativa* had little effect on CAR but it seemed to decrease the CAR blocking action of chlorpromazine. It impaired the learning process while chlorpromazine did not affect the learning process in a dose of 0·5 mg./kg. The administration of *C. sativa* and chlorpromazine together reduced the degree of impairment caused by *C. sativa* when given alone (Srivastava *et al.*, 1971).

Cannabinol, in a dose of 200 mg./kg., induced sleep in mice which was unaffected by pre-treatment with chloramphenicol succinate (50 mg./kg.). Cannabinol, however, potentiated the response of pentobarbital sodium. In dogs cannabinol had similar

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effects in producing anaesthesia. In anaesthetized dogs cannabinol reduced the urinary outflow (Singh, 1973).

Cannabis caused selective inhibition of flexor reflex and lingulomandibular reflex, without impairment of neuronal transmission and monosynaptic patellar reflex. This inhibitory response was found to be abolished by a high spinal transection and reversed by strychnine, suggesting a reticular site of action.

Electroencephalographic studies have shown that cannabis decreases the rhythm of α-frequency in animals. Neuropharmacological studies with synthetic THC demonstrated the principal site of action to be in the cerebrum, and it was without any effect on the brain stem activating system except in large doses when an elevation of threshold was observed.

Cannabis and its derivatives were found to be relatively non-toxic in animals. Mortality at very high doses was due to respiratory arrest. The prolonged administration of cannabis in rats and mice did not result in any abnormality in the offsprings.

The toxic effects of marihuana reported in human beings are psychotic episodes like nausea, dysphoria, tremors etc., which usually subside with the passing of time. Toxic effects of prolonged cannabis use in chronic users include lassitude, indifference, lack of productive activity, insomnia, headache, nystamgus, increased susceptibility to infections, gastro-intestinal disturbances, sexual impotence and personality changes.

The slow and prolonged hypotensive action of cannabis and its interaction with catecholamines in the peripheral system suggests the possibility of an interaction with the brain amines being responsible for the behavioural effects observed (Arora *et al.*, 1972).

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*Cannabis sativa*

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*Carica papaya*

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## CANSCORA (Gentianaceae)

*C. DECUSSATA* Roem. et Sch.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Dankuni | Mar. and Kon. | — | Shankha-pushpi |
| Hind. | — | Shankhini | Mal. | — | Causjan, cora |

**Habitat :** Erect branching annual found throughout India and Burma, with four winged stems and decussate branches.

**Parts used :** Entire plant and fresh juice.

**Ayurvedic description**

Sanskrit : *Shankhapushpee.*

Synonyms : *Shankha, kireetee, kambumaalini, shankhaahulee, medhya, varnavilaa sinee, ksheerapushpee, manorama,, shivabrahee, bhootalata, maangalya-pushpee, shankhaahwa, maangalyaanya, raktapushpee, subhadra, sookshmapatrika, smritihita, sarpaakshee, neelapushpika*

Note : *Shankhapushpee* is indentified by some as *Evolvulus alsinoides.*

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Properties : *Rasa* — *Kashaaya, katu, madhura*
*Guna* — *Sara, snigdha, anooshna, picchila, guru,*
*Veerya* — *Ushna*
*Vipaaka* — *Madhura*

Actions/Uses : *Swarya, varnakara, agnideepta, balakara, kaantida, ayuhvridahikara, apasmaaraghna, loothahara, kushtaghna, bhootahara, vishaghna, krimighna, chetavikaarinee, rasaayanee, smritivriddhikara, mohanaashinee*

**Medicinal properties and uses :** Fresh juice is given in insanity, epilepsy, scrofula and nervous debility. A paste of entire plant including roots and flowers is recommended with milk as a nervine tonic (Nadkarni, 1954).

**Chemistry :** Two crytaline compounds were isolated from the alcoholic and aqueous extracts of the entire plant (Madan, 1960*a*).

A number of known and new triterpenes, alkaloids and xanthones were isolated from the roots of *C. decussata.* (Ghosal *et al.*, 1971). The roots contained 16 xanthones of which six were previously not reported in nature. Chemical and spectral methods and comparison with authentic samples were used to establish their identity (Chaudhuri and Ghosal, 1971).

**Pharmacology :** Out of two soluble crystalline fractions (I and II) isolated from the alcoholic and aqueous extracts of the plant respectively, fraction I produced a fall in the blood pressure and reduced the rate and force of contraction of dog's heart. It caused stimulation of the smooth musculature of isolated rabbit's intestines as well as uteri of rat and guineapig and enhanced the effect of acetylcholine on the skeletal muscles. Fraction II did not show any of these actions but significantly prolonged the sleeping time of rats due to pentobarbital sodium. Fraction II was found to be less toxic than Fraction I (Madan, 1960*a*).

The spermicidal activity of fractions I and II were studied *in vitro* on human semen and rat's sperm suspension. The minimum concentration of fractions I and II required to kill all the rat's sperms in 5 minutes were found to be 1 : 50,000 and 1 : 20,000 respectively. Human semen was found more resistant and larger doses were required of both the fractions for exerting a spermicidal effect (Madan, 1960*b*).

The alcoholic extract of the entire plant was found to have CNS depressant activity in mice. It also possessed anti-viral activity against *Ranikhet disease virus* (Bhakuni *et al.*, 1969).

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## CAPPARIS (Capparidaceae)

*C. DECIDUA* Edgew. (Syn. *C. aphylla* Roth.)

| | | | | | |
|---|---|---|---|---|---|
| Eng. | — | Caper plant | Punj. | — | Karia |
| Hind. | — | Kachra | Tam. | — | Shengam |
| Kan. | — | Nispatige | Tel. | — | Enugadanta |
| Mar. | — | Nepati | | | |

**Habitat :** Found in the deserts of Rajputana, Punjab and Sind.

**Parts used :** Entire plant, root bark and fruits.

**Ayurvedic description**

| | | |
|---|---|---|
| Sanskrit : | *Kareera* | |
| Synonyms : | *Krakara, apatra, granthila, marubhooruha, nigoodhapatra, kantakeevriksha, mriduphala, karata.* | |
| Properties : | *Rasa* | — *Katu, tikta, kashaaya* |
| | *Guna* | — *Laghu, teekshna, sara.* |
| | *Veerya* | — *Ushna* |
| | *Vipaaka* | — *Katu* |
| Actions/Uses : | *Bhedana, graahi, swedya, shothahara, vranaghna, vishaghna, ruchi-prada.* | |

**Medicinal properties and uses :** Root-bark is astringent and alterative while whole plant is regarded as acrid, stimulant and laxative. The drug is a counterirritant (Chopra *et al.*, 1956; Nadkarni, 1964).

*C. moonii* Wight.

Commonly known as *rudanti.*

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**Habitat :** A large, climbing shrub growing widely in the western ghats and in Kanara and Khandala.

**Parts used :** Fruit

**Medicinal properties and uses :** It is used for healing sores, burns and wounds. Half mature fruits are used in the treatment of pulmonary tuberculosis (Shah and Sukkawala, 1959).

*C. SEPIARIA* Linn.

| | | | |
|---|---|---|---|
| Ben. | — Kaliakara | Punj. | — Hiungarna |
| Hind. | — Kanthari | Tam. | — Karunjurai |
| Mar. | — Kanthar | Tel. | — Nallavuppi |

**Habitat :** A branched woody climber found in dry parts of India.

**Parts used :** Whole plant.

**Ayurvedic description**

Sanskrit : *Kaakaadanee*

Synonyms : *Grdihranakhee, kantharee, duhpradarsha, hinara, tundi, kala.*

Properties :
*Rasa* — *Katu, tikta*
*Guna* — *Laghu*
*Veerya* — *Ushna*
*Vipaaka* — *Katu*

Actions/Uses : *Deepana, ruchya, raktadoshaghna, granthirogaghna, snaayurogaghna, shophahara, kushtaghna, kandooghna, shvitrahara, jwaraghna.*

**Medicinal properties and uses :** It is a febrifuge, alterative, tonic and also useful in skin diseases.

*C. ZEYLANICA* Linn. (Syn. *C. horrida* Linn. f.)

| | | | |
|---|---|---|---|
| Ben. | — Kalo-kera | Punj. | — Karvila |
| Hind. | — Govindaphal, ardanda | Tam. | — Adondai |
| Mar. | — Wag | Tel. | — Adonda |

**Habitat :** Occurs throughout India.

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**Parts used :** Root-bark and leaves.

**Ayurvedic description**

Sanskrit : *Vyaaghranakhee*

Synonym : *Gaandhaaree*

Properties :

| | | |
|---|---|---|
| *Rasa* | — | *Katu, tikta* |
| *Guna* | — | *Laghu* |
| *Veerya* | — | *Ushna* |
| *Vipaaka* | — | *Katu* |

Actions/Uses : *Shothahara, vedanaasthaapana, ruchya, deepani, raktashodhaka.*

**Medicinal properties and uses :** Root-bark is bitter, cholagogue, sedative, diuretic, stomachic, antihidrotic and is useful in cholera. Leaves are counter-irritant and used in boils, swellings and piles (Chopra *et al.*, 1956; Nadkarni, 1954).

**Pharmacognosy :** The pharmacognostic studies of the fruits of *C. moonii* have been carried out.

Macroscopic characters : Fruits of *C. moonii* measure 5 to 10 cm. in diameter and are green-grey to red in colour. A prominent ridge passes half way round the circumference. Seeds are ex-albuminous. Fracture of the pericarp is granular, taste is slightly astringent and smell is strong.

Microscopic characters : The epidermis and pericarp are filled with brown pigment and is under a thick layer of cuticle. The hypodermis is made of 12-18 layers of tangentially elongated parenchymatous cells, which is followed by patches of stone cells. Parenchymatous tissue shows a few vascular bundles; phloem is usually crushed and looks yellowish or yellowish grey mass in dry fruits. The testa of the seed is crustaceous and has 4-6 rows of stone cells only. Tegmen is papery and thin. Cotyledons contain fixed oil.

Fluorescence analysis has also been carried out. Microchemical tests have revealed the presence of starch and tannins, but no alkaloids (Shah and Sukkawala, 1959).

By a comparison of the authentic samples of the fruits and entire plants of 'Khandala' and 'Konkan' varieties of *C. moonii*, it has been found that the correct botanical identity is *C. horrida* and not *C. moonii* (Shah and Sukkawala, 1961).

Pharmacognostical studies have also been carried out on *C. zeylanica.*

Macroscopic characters : The root-bark occurs in curved pieces and is yellowish green in colour. The stem-bark also occurs in curved pieces and has longitudinal and

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zig-zag furrows, transverse irregular cracks and a few lenticles in the outer surface. Spines are also present. The odour is characteristic and the taste bitter.

Microscopic characters : In a young root, the epidermis is followed by 2-3 layers of parenchymatous cortex. The endodermis has casparian dots on the anticlinal walls. The pericycle encloses a triarch stele. The root-bark has outer cork composed of irregular cells. The secondary phloem has sieve elements, parenchyma, fibres, stone cells and is traversed by medullary rays.

The young stem has a single layered epidermis which is covered by a thick cuticle, followed by 6-10 layers of parenchymatous cortex. A complete ring of fibres, interspersed by stone-cells encircling the vascular cylinder is formed. Secondary growth also takes place.

In the stem-bark, cork is stratified with 3-4 stratifications and shows rhytidome formation. The secondary phloem is a comparatively wider zone than the phelloderm. Stone cells are present in the outermost layers of phloem. The medullary rays are 1-3 cells wide and are oval to isodiametric. The cambium remains intact with bark and is represented by 3-4 layers of thin walled, tangentially elongated cells.

Tannin and resin are found present in the parenchymatous cells of the phelloderm and phloem regions of the root and stem barks. Fluorescence analysis has also been done (Ansari and Gupta, 1971).

**Chemistry :** By column chromatography of unsaponifiable fraction of fat obtained from petroleum ether extract of *C. decidua*, n-pentacosane, n-triacontanol and β-sitosterol were isolated and identified. From the alcoholic extract, a water soluble alkaloid, L-stachydrine (0·10 per cent) was isolated. Another chloroform-soluble alkaloid (0·15 per cent) has also been isolated (Gaind and Juneja, 1969).

From the unsaponifiable fractions of the petroleum ether extract of flowers and fruit husk of *C. decidua*, the constituents isolated were n-pentacosane, n-triacontane, n-triacontanol and β-sitosterol. The fruit husk, in addition, also contained β-carotene. The unsaponifiable matter from seeds contained n-pentacosane, n-triacontanol and β-sitosterol but n-triacontane was absent. From the saponifiable matter of flowers and fruit husk, phthalic acid was isolated. From ethanol extracts of flowers, fruit husk and seeds, L-stachydrine was isolated, fruit husk having maximum amount of L-stachydrine alongwith choline in traces (Gaind and Juneja, 1970).

An isothiocyanate glucoside, identified as glucocapparin m.p. 195° (decomp.) with molecular formula $C_8H_{14}O_9NS_2K$ was isolated from the seeds of *C. decidua* (Juneja *et al.*, 1970*a*).

Preliminary investigations were carried out on the rootbark, stem, leaves and flowers of *C. sepiaria*. Alkaloids, glycosides, carbohydrates, anthocyanins, flavonoids, sterols, terpenes and amino acids were found present. In the unsaponifiable

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matter of leaves the presence of β-sitosterol, betulin and two new terpenoid alcohols has been reported (Juneja *et al.*, 1970*b*).

**Pharmacology :** Purgative activity of the ether, alcohol and aqueous extracts of root bark of *C. decidua* and an alkaloid isolated from the bark was studied in albino rats. The aqueous extract had high purgative activity followed by the alkaliod and alcoholic extract. Ether extract had no activity. The aqueous extract was found to contain potassium tartrate and the purgative activity appeared to be due to its presence (Gaind *et al.*, 1969*a*).

Anthelmintic activity of the aqueous and alcoholic extracts of flower, fruit pulp, seeds and root bark of *C. decidua* was studied on earthworms. Hexylresorcinol was used as a standard drug for comparison. The aqueous extracts had more anthelmintic activity than the alcoholic extracts (Gaind *et al.*, 1969*a*).

The alcoholic extracts of the flowers, fruit husk and seeds of *C. decidua* were highly active against various bacteria *viz. S. aureus*, *E. coli*, *B. subtilis*, *P. vulgaris*, *B. megaterium* and *V. cholerae* (*inaba*) but none of the extracts had antifungal activity. A steam volatile, organic, sulphur-containing compound isolated from the seeds of the plant showed high antibacterial as well as antifungal activity. This compound was found to have high activity (25 mg./ml.) against *V. cholerae*, var. *inaba* and *ogawa* (Gaind *et al.*, 1969*b*).

Kinetics of the *in vitro* antibacterial activity against *V. cholerae* (*ogawa*, *inaba* and *el tor*) were studied using the isolated sulphur compound. The active principle was found effective against all the three species of *V. cholerae*. In case of *V. cholerae ogawa*, with 25 µg./ml. concentrations of the active principle, complete inhibition was observed within 5 hours whereas in case of *inaba*, complete inhibition was achieved within 13 hours with 60 µg./ml. of the compound. 20 µg./ml. concentration had a bacteriostatic action for 12 hours. In case of *V. cholerae el tor*, complete inhibition was found in 5 hours with 75 µg./ml. of the active principle (Gaind *et al.*, 1972).

The alcoholic extract of the aerial parts of *C. longispina* was found to have anti-viral activity against *Ranikhet disease virus* (Dhar *et al.*, 1968).

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## CARDIOSPERMUM (Sapindaceae)

*C. HALICACABUM* Linn.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Nayaphataki | Mal. | — | Uzhinja, palloolavam |
| Eng. | — | Balloon vine, winter cherry | Mar. | — | Kanphuti |
| Guj. | — | Karocho | Mar. | — | Punj—Habul-kalkal |
| Hind. | — | Kanphata | Tam. | — | Valulavae, mudakkitaan |
| | | | Tel. | — | Buddakakara |

**Habitat :** Found chiefly in Bengal and Uttar Pradesh.

**Parts used :** Entire herb, roots, leaves and seeds.

**Ayurvedic description**

Sanskrit : *Indravalli*

Synonyms : *Karavi, karnasphota, jyotishmati, tejovati.*

Properties : *Rasa* — *Katu, tikta*
*Guna* — *Teekshna, snigdha, sara.*
*Veerya* — *Ushna*
*Vipaaka* — *Katu*

Actions/Uses : *Jwaraghna, vaataghna, vriddhinaashani.*

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**Medicinal properties and uses :** Root and the leaves are diuretic, laxative, stomachic, alterative and emetic, externally used as arubefacient (Nadkarni, 1954).

**Chemistry :** The alcoholic extract of the fat-free residue left after petroleum ether extraction of air dried plant, yielded a crystalline product m.p. 150°, which formed an acetate with pyridine and acetic anhydride. The compound was identified as stigmasterol which was probably present in the form of a glycoside (Dass, 1966).

The presence of β-sitosterol, phlobaphene and phlobatannin in the roots of Indian samples has been reported previously. Past chemical work on the plant *C. halicacabum* reported the presence of quebrachitol, which is a monomethyl ether of inositol, β-sitosterol and the presence of a saponin or saponins. In view of the importance of this drug in Indian medicine, a re-examination was undertaken and two lots of the plant obtained from widely separated regions were studied. From the acetone extract of the material collected from Dehra Dun, quebrachitol was isolated in poor yield. Isolation of a proanthocyanidin and apigenin from the alcoholic extract and their characterisation by chemical and physical methods have been reported.

The material collected in Bengal was examined for its polyphenolic constituents. Proanthocyanidins could not be detected but apigenin was isolated and characterised by chemical, spectral and chromatographic methods. It occurred in the plant in combination with glucose. The presence of saponins indicated by earlier workers could not be substantiated in either batch of the material (Ayengar, 1967—Personal communication).

**Pharmacology :** The essential oil obtained from the seeds of the plant showed an immediate fall in blood pressure of anaesthetized dogs, lasting for an hour and a half. Atropinization did not alter the effect of the essential oil. Lower doses of the oil (20-100 mcg.) caused a marked stimulation of isolated frog's heart. It caused an increase in the tone of isolated rabbit's intestine. Higher doses completely relaxed the intestine.

The water soluble fraction of the dried alcoholic extract of the seeds caused a prolonged hypotensive effect in anaesthetized dogs, which was not affected by pretreatment with atropine sulphate. It caused an inhibition of movements of isolated rabbit's intestine. An initial depression followed by marked stimulation in isolated frog's heart preparation was observed with the water soluble portion of the extract (Modi and Deshmankar, 1972).

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## CAREYA (Myrtaceae)

*C. ARBOREA* Roxb.

| | | | | | |
|---|---|---|---|---|---|
| Guj., Mar. and Ben. | — | Vakumbha | Mal. | — | Peelam |
| Hind. | — | Mumbi | Tam. | — | Aeimamaram |
| Kan. | — | Daddala | Tel. | — | Dudippi |

**Habitat :** Large deciduous tree. Found frequently in Sub-Himalayan tract from Jumna eastward.

**Parts used :** Bark, fruit, flowers and juice.

**Ayurvedic description**

Sanskrit : *Kumbhee*

Synonyms : *Mahaashwetaa, katabhee, kinihee, lohinee, girikarnika, shireeshapatra, kaalindee, beejapoora, pindika, neelapushpa*

Properties : *Rasa* — *Kashaaaya, katu*
*Guna* — *Laghu*
*Veerya* — *Ushna*
*Vipaaka* — *Katu*

Actions/Uses : *Graahee, shwitraghna, vranahara, shirorogaghna,*

**Medicinal properties and uses :** Bark and fruit are astringent. Juice of bark is demulcent (Nadkarni, 1954).

**Chemistry* :** The plant forms a rich source of saponins. A sapogenin has been isolated from the seeds of *C. arborea.* From the benzene-ether eluate of the petroleum ether extract of the leaves, taraxerol has been isolated as yellowish crystalline residue which, on further purification, crystallised as colourless plates, m.p. 273-276°, molecular formula $C_{30}H_{50}O$. When acetylated with pyridine and acetic anhydride, it furnished an acetate, $C_{32}H_{52}O_2$, m.p. 297-299°. On treatment with pyridine and benzoyl chloride, it afforded a benzoate, $C_{37}H_{54}O_2$, m.p. 290-292°. The physical and chemical properties were in agreement with taraxerol (Mahato *et al.*, 1967).

*No report available on other aspects.

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**Reference**

Mahato, S.B., Banerjee, S.K. and Chakravarti, R.N. 1967. Taraxerol from *Careya arborea*. **Bull Calcutta Sch Trop Med 15,** 9

## CARICA (Caricaceae)

*C. PAPAYA* Linn.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Papaya | Mal. | — | Kappalam |
| Eng. | — | Papaw or Papaya tree | Mar. | — | Popai |
| Guj. | — | Papai | Punj. | — | Arand-Kharpuza |
| Hind. | — | Popaiyah, papita | Tam. | — | Pappaalai |
| Kan. | — | Parangi, papaaya | Tel. | — | Bappayi |
| Kon. | — | Poppaye-phal | | | |

**Habitat :** Commonly cultivated in gardens throughout India.

**Parts used :** Milky juice, seeds and pulp.

**Ayurvedic description**

Sanskrit : *Erandakarkatee*

Synonyms : *Madhukarkata, erandachirbhata, koshaphala, apakwa, harita, peeta-phala, swaaduphala, priya*

Properties : *Rasa* — *Madhura*
*Guna* — *Laghu, rooksha, teekshna*
*Veerya* — *Ushna*
*Vipaaka* — *Madhura*

Actions/Uses : *Agniuttejaka, udararogaghni* (specially in *yakrit* and *pleeha vikaaras*), *mandaagni, shothahara.*

**Medicinal properties and uses :** Juice of the green fruit acts as an emmenagogue and in large doses as ecbolic. Fresh milky juice is rubefacient. Ripe fruit is digestive and alterative. The green fruit is a laxative and diuretic (Nadkarni, 1954).

**Chemistry :** From the seeds of *C. papaya* a substance with m.p. 165°, molecular formula $C_8H_{10}N_2S$, was isolated and named carpasemine. Chemical properties of this compound together with its degradation products have been studied and some new

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derivatives have been prepared from it. Carpasemine has been identified as benzyl-thiourea or benzylthiocarbamide, by mixed melting point with the synthetically prepared benzylthiourea. The identity was also confirmed by mixed melting points of their derivatives (Panse and Paranjape, 1943).

Nineteen different carotenoids were identified in the fruit, the major being cryptoxanthene (48 per cent). Oxycarotenoids were higher in proportion as compared to carotene hydrocarbons. The percentage of cryptoflavin and β-carotene were 13 and 29·5 respectively. Oxygenated carotenoids present were either hydroxy or epoxy carotenoids of β-carotene (Subbarayan and Cama, 1964).

The mass spectrum of pseudocarpaine isolated from the plant showed that it was dimeric. The fragmentation pattern observed for pseudocarpaine was identical with that of carpaine but for minor difference in the relative intensities of the ions. The two alkaloids had the same gross structure. Pseudocarpaine on acid hydrolysis yielded carpamic and pseudocarpamic acids. The NMR data provided confirmatory evidence for the build up of pseudocarpaine from two dissimilar halves, one represented by carpamic acid moiety and the other by pseudocarpamic acid residue (Govindachari *et al.*, 1965).

**Pharmacology :** The petroleum ether extract of the pulp of *C. papaya* exerted significant antifertility activity in female albino rats (Garg and Garg, 1971).

The latex of the green fruit has been reported to possess oxytocic activity of a high order. The seeds decreased fertility of albino mice but were highly toxic (Saha *et al.*, 1961, Sareen *et al.*, 1961).

The aqueous extract obtained from the latex of *C. papaya* exhibited anticoagulant activity both against plasma and whole blood. No clotting was observed even after 24 hours (Pillai *et al.*, 1957).

An anticoagulant principle (AC 48) isolated from the latex of *C. papaya* has been found to increase the prothrombin time and coagulation time in dogs, rabbits, rats and mice. The maximum activity was found after intravenous administration within 30 minutes. On intramuscular injection, only feeble anticoagulant activity was observed along with painful swelling and hematoma. A dose of 2 mg./kg. i.v. in dogs increased prothrombin time three-fold. The maximum dose tolerated by rats and mice was 50 mg./kg., while therapeutic effectiveness was observed at 1-2 mg./kg. Acute toxic effects at higher doses were similar to those found with anticoagulants like heparin (Chandrashekar *et al.*, 1961*a*).

A higher dose of the anticoagulant principle (AC 48) caused depression of the dog's heart. It acted as a spasmogen on the smooth muscle of guineapig ileum. Slight

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contraction was observed even with 1 mcg./ml. concentration, while higher doses induced a greater degree of spasm (Chandrashekhar *et al.*, 1961*b*).

The cold aqueous extract, hot infusion and the resin fractions of the seeds stimulated isolated rat intestine and depressed frog's heart. The alkaloidal solution showed depressant action on heart, blood pressure and intestine. All the fractions paralysed the earthworm (*Pheretima posthuma*) and rat tapeworm *in vitro*. The *in vivo* studies showed a reduction in the ova count and expellation of the tapeworm in a significant number of rats. The resin was found to be the most potent amongst all the fractions (Bose *et al.*, 1961).

Out of the various compounds isolated from the seeds of the plant and tested against *Ascaris lumbricoides*, only benzylthiourea was found to be mainly responsible for anthelmintic activity. It did not cause any toxic symptoms except local irritation even in doses of 30 mg./kg. of rats (Dar *et al.*, 1965).

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# CARISSA (Apocynaceae)

*C. CARANDAS* Linn.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Karamcha | Mar. | — | Karvand |
| Hind. | — | Karaunda | Tam. | — | Kalaakai |
| Mal. | — | Karakka | Tel. | — | Vaka |

**Habitat :** Grows wild throughout India; also cultivated for its fruit.

**Parts used :** Fruit, bark, leaves and root.

**Ayurvedic description**

Sanskrit : *Karamardika*

Synonyms : *Krishnapaakaphala, sushena, vanakshudra, ksheeraphena, amlapushpa, paanimardaka, karaamla, sthoolakarkataka*

Properties :

| | | |
|---|---|---|
| *Rasa* | — | *Amla* |
| *Guna* | — | *Guru* |
| *Veerya* | — | *Ushna* |
| *Vipaaka* | — | *Amla* |

Actions/Uses : *Ruchya, trishnaahara, deepani, graahi, raktapittahara, twagdoshahara*

**Medicinal properties and uses :** Fruits are stomachic, antiscorbutic, refrigerant and digestive. Root is bitter, stomachic and anthelmintic. Unripe fruits are astringent and antiscorbutic. Decoction of leaves is given at the commencement of remittent fever (Chopra *et al.*, 1956; Nadkarni, 1954).

*C. SPINARUM* Linn.

| | | | | | |
|---|---|---|---|---|---|
| Hind. | — | Karaunda | Sans. | — | Karamardika |
| Kash. | — | Garaunda | Tam. | — | Shirukalaakkai |
| Punj. | — | Garna | Tel. | — | Kalivi |

**Habitat :** Throughout India in dry regions, specially in Punjab, Kashmir and North-West Frontier province.

**Parts used :** Root and fruit.

**Medicinal properties and uses :** Root is ground and put in worm-infested sores of animals. It enters into the composition of purgatives (Chopra *et al.*, 1956). Roots are also used in rheumatism whereas fruits are edible (Bhatnagar and Raina, 1970).

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**Pharmacognosy :** Pharmacognostic studies have been carried out on the root of *C. spinarum*. The tap roots are laterally branched, cylindrical and yellowish in colour. The roots have no distinct taste or odour.

Microscopically, the root shows a distinct stratified cork followed by cortex containing numerous large cavities and groups of stone cells. The cortical parenchyma contains starch and prismatic crystals of calcium oxalate. Sieve tube elements are not distinct. The phloem parenchyma is characterised by the presence of rectilinear crystals of calcium oxalate. Xylem consists of vessels, tracheids, fibres and xylem parenchyma.

The ash values and the fluorescence characters of the powdered roots have also been determined (Bhatnagar and Raina, 1970).

**Chemistry :** From *C. congesta*, glucoside of β-sitosterol, carissone and a bitter oil have been isolated (Joshi and Boyce, 1957).

Four new crystalline substances designated as A, B, C, and D were isolated from the roots of *C. carandas*. Substance C had molecular formula $C_{23}H_{30}O_4$ and was found to be cardioactive as confirmed by pharmacological tests. Some novel chemical features were indicated by spectral data, hydrogenation and acetylation experiments. An amorphous water-soluble polyglycoside fraction with high cardiac activity has been isolated. Another crystalline substance P, carissone and β-sitosterol have also been isolated. Substance P was crystallised from ethanol as colourless needles, m.p. 262°, molecular formula $C_{31}H_{33}O_6$ (Rastogi *et al.*, 1966).

Enzymatic and mild hydrolysis of polar glycosides from *C. carandas* yielded odoroside H, digitoxigenin, possibly anhydrodigitoxigenin, glucose and D-digitalose. The cardiotonic activity of this glycosidic fraction was due to the presence of glucosides of odoroside H. The monoside odoroside H, or its genin digitoxigenin, could not be detected as such in this plant (Rastogi *et al.*, 1967).

A series of substituted hydrazones, carbohydrazones, thiocarbohydrazones, carbazate, *etc.* derived from carissone, α-cyperone, 4, 5-dihydrocarissamine, and 4 H, 5-cyanocarissone have been synthesized. The structure of 4 H, 5-cyanocarissone was confirmed through its IR and UV spectral data (Bhaduri *et al.*, 1968).

From the leaves, several compounds were isolated *viz.* Lupeol-$C_{30}H_{50}O$, β-sitosterol-$C_{29}H_{50}O$, a triterpene alcohol and ursolic acid $C_{30}H_{48}O_3$. From stem bark β-sitosterol and lupeol were obtained from neutral parts (Pakrashi *et al.*, 1968).

Various spectroscopic and chemical methods were employed to derive the structure of carindone as a novel type of $C_{31}$- terpenoid isolated from *C. carandas* (Singh and Rastogi, 1972).

Five cardiac glycosides have been isolated from *C. spinarum*. These were identified as odoroside H, evomonoside and odoroside G. The remaining two substances

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were identified as rhamnoside and rhamno-glucoside respectively, whose genins have not been characterised (Rastogi *et al.*, 1969).

Caffeic acid has been isolated from *C. spinarum* roots. Although this compound was known to occur in numerous plant species, its actual isolation has been reported only from a few sources. The elemental analysis supported the molecular formula $C_9H_8O_4$. The superimposable UV, IR spectra and mixed melting point determination confirmed the compound as caffeic acid (Raina *et al.*, 1971).

**Pharmacology :** The alcoholic fraction of the roots of *C. carandas* caused a significant fall of blood pressure in cats both in depth as well as in duration (Chatterjee and Roy, 1965).

The alcoholic extracts of root, stem and leaf of *C. carandas* and *C. spinarum* showed positive inotropic activity on hypodynamic guineapig heart and isolated papillary muscle preparation of cat. The ECG changes produced in cats were typical of a cardenolide. The cardiotonic activity of *C. spinarum* was found to be 4-6 times greater than that of *C. carandas* (Vohra and De, 1963).

The alcoholic extract of *C. carandas* roots produced vomiting, rhinorrhoea, diarrhoea, tachypnea, exhaustion and finally death in conscious cats. In aneasthetized cats it produced a biphasic hypotensive effect. The initial evanescent effect was abolished by atropine whereas the second prolonged hypotensive effect was reduced by mepyramine maleate. The histamine releasing effect was observed by estimating plasma histamine in cats, histamine content in rat hind-limb perfusate as well as in the lung tissue. Compound 48/80 produced more complete release of histamine than the extract (Joglekar and Gaitonde, 1970).

The alcoholic extract of the aerial parts of *C. opacea* was found to have CNS depressant activity in mice (Bhakuni *et al.*, 1971).

Carissone-3-(0-carboxyphenyl) hydrazone, 3, 3′-bis-(carissyl) thio-carbohydrazone and carissone-3-$N^1$-homopiperidyl hydrazone exhibited antizygotic, antimycobacterial and atropine-like spasmolytic activity respectively (Bhaduri *et al.*, 1968).

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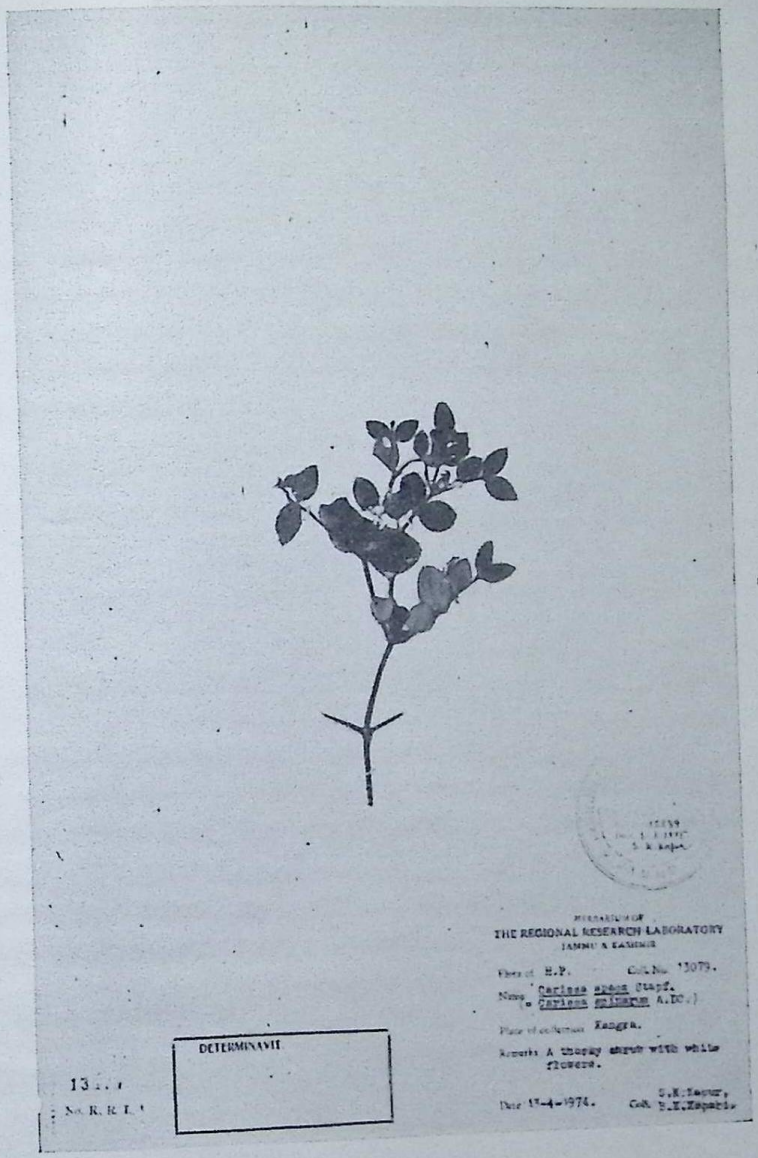


*Carissa spinarum*

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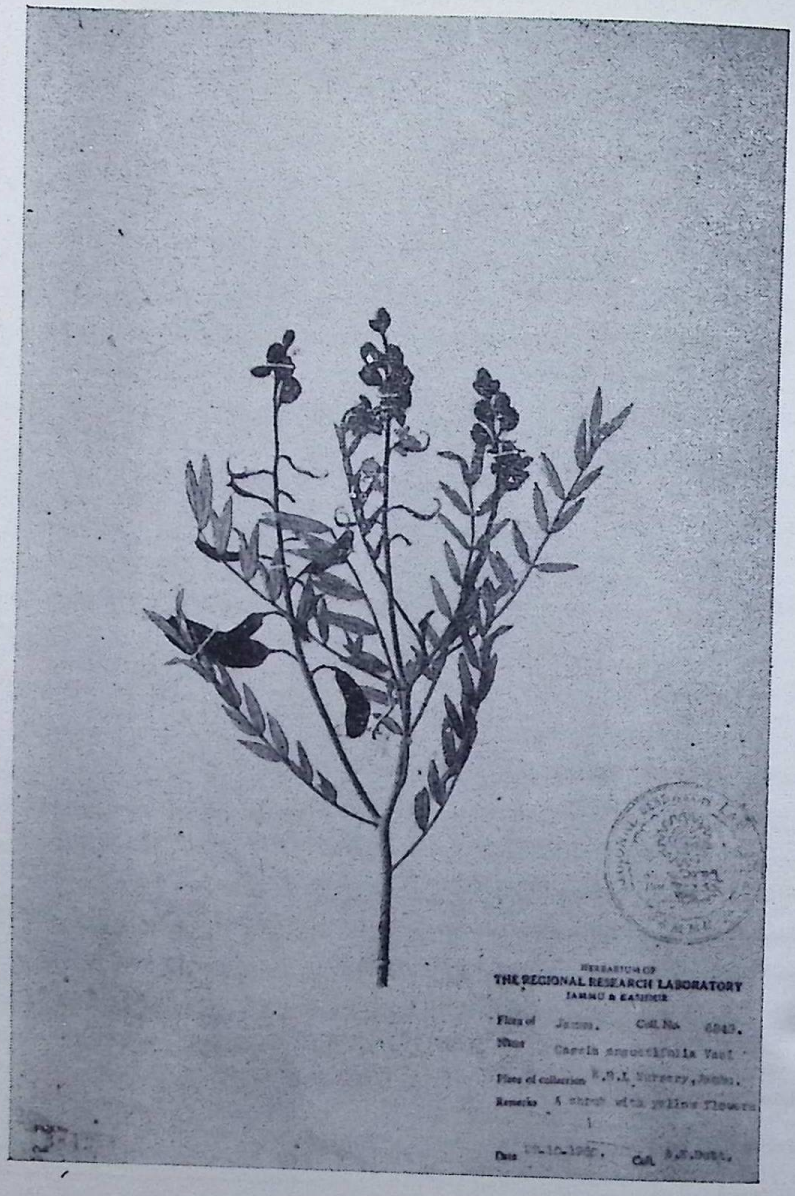


*Cassia angustifolia*

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## CARTHMAUS (Compositae)

*C. TINCTORIUS* Linn.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Kajiret | Mal. | — | Chendurakam |
| Eng. | — | Saf-flower | Mar. | — | Kardai |
| Guj. | — | Kusumbi | Tam. | — | Sendurakam |
| Hind. | — | Kusumbar | Tel. | — | Agni-sikha |
| Kan. | — | Kusubi | | | |

**Habitat :** Grows in tropical and subtropical parts of India. There are two varieties : with non-spinous and spinous leaves, of which the latter is useful in oil production.

**Parts used :** Whole plant, seeds, roots and flowers.

**Ayurvedic description**

Sanskrit : *Kusumbha*

Synonyms : *Kantakee, vyaagreedala, kantaphala, vanhishika, vastraranjaka*

Properties : (General)

| | | |
|---|---|---|
| *Rasa* | — | *Madhura, kashaaya* |
| *Guna* | — | *Guru, vidaahi* |
| *Veerya* | — | *Ushna* |
| *Vipaaka* | — | *Katu* |

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Actions/Uses : *Krimighna, mootrakritchrashamana, raktapittashamana, agnikaaraka, ruchya, malamootrashodhaka, pushtikara, balahara*

Leaves :

Properties : *Rasa* — *Madhura, amla, katu*
*Guna* — *Guru, sara, rooksha*
*Veerya* — *Ushna*
*Vipaaka* — *Katu*

Actions/Uses : *Chakshushya, rochaka, gudarogahara, madahara, malamootrashodhaka*

Seeds :

Properties : *Rasa* — *Madhura, kashaaya*
*Guna* — *Snigdha, guru*
*Veerya* — *Sheeta*
*Vipaaka* — *Madhura*

Actions/Uses : *Avrishya, raktapittashamana, drikhrit, shukrahrit*

**Medicinal properties and uses :** Seeds are used as purgative while roots are used as diuretic (Nadkarni, 1954). Oil has been reported to lower the level of blood serum cholesterol mainly due to the presence of oleic acid and linoleic acid. It has also been considered useful in arteriosclerosis, atherosclerosis and infant eczema (Tiwari *et al.*, 1970).

**Chemistry* :** The plant which could be cultivated successfully in poor sandy soil of Kumaon hills (Ranikhet), gave a yield of 338 kg. seeds/hectare of good quality with fair percentage of oil. Properties of oil compared well with those reported in literature. Yield of the seed was considerably influenced by nitrogen. Extraction of the oil was done by using diethyl ether as solvent (Tiwari *et al.*, 1970).

There are two varieties as regards flower colour, (1) deep yellow, turning orange red and (2) ivory coloured. The former has been used for extracting a costly dye, carthamin paste, which has been used also as a drug. A detailed examination has been made of the two varieties. The coloured flowers yield as major components a deep yellow chalkone glucoside named carthamin. A deep red quinone related to carthamin is a minor component and it has been named carthamone and it dyes cotton directly. The ivory white flowers yield a colourless flavanone glucoside corresponding to carthamin and has been named as neo-carthamin (Seshadri and Thakur, 1960, Murti *et al.*, 1962).

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*No report available on other aspects.

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## CARUM (Umbelliferae)

*C. BULBOCASTANUM* Koch.

Hind. — Kala-zira
Kash. — Gunyun
Mal. — Shima-jirakam
Tam. — Shiemaishombu
Tel. — Sima-julakara

**Habitat :** Found in Kashmir at 2000-3000 m. and in Baluchistan.

**Parts used :** Fruits.

**Medicinal properties and uses :** The fruits are stomachic and carminative (Chopra *et al.*, 1956).

*C. COPTICUM* Benth. (Syn. *Trachyspermum ammi* (Linn.) Spragne, *Ptychotis ajowan* DC)

Ben. — Jowan
Hind. — Ajowan
Kan. — Omu
Mar. — Ajwan
Tam. — Omum
Tel. — Omaum

**Habitat :** Cultivated extensively in Indian gardens.

**Parts used :** Fruits and roots.

**Ayurvedic description**

Sanskrit : *Yavaani*

Synonyms : *Ajamodaka, deepyaka, yavanaka.*

Properties : *Rasa* — *Katu, tikta*
*Guna* — *Laghu*
*Veerya* — *Ushna*
*Vipaaka* — *Katu*

Actions/Uses : *Analadeepani, paachani, deepani, ruchya, grahanee, gulmaghna, udaraghna, shothaghna, hikkaahara, aruchighna, shoolaghna, aadhmaanaghna, aanaahaghna, krimighna, arshoghna, chardihara, pleeharogaghna.*

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**Medicinal properties and uses :** Fruits are antiseptic, stomachic, carminative, stimulant, tonic and also used in diarrhoea, colic, flatulence, indigestion and cholera, (Chopra *et al.*, 1956).

*C. CARVI* Linn.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Jira | Mar. | — | Wilayti Zirah |
| Hind. | — | Jeera | Punj. | — | Zira-siah |
| | | | Tam. | — | Shimai jeerakam |

**Habitat :** It grows wild in north Himalayan regions and is cultivated in the plains as a cold season crop and in the hills of Kashmir, Kumaon, Garhwal and Chamba at 3,000-4,000 m. as a summer crop.

**Parts used :** Fruits.

**Ayurvedic description**

Sanskrit : *Krishnajeeraka*

Synonyms : *Jarana, karavee, kaashmeerajeeraka*

Properties :

| | | |
|---|---|---|
| *Rasa* | — | *Katu* |
| *Guna* | — | *Laghu, rooksha* |
| *Veerya* | — | *Ushna* |
| *Vipaaka* | — | *Katu* |

Actions/Uses : *Rochana, deepana, paachana, graahi, medhya, vrishya, chakshushya, balya, stanyajanaka, hridrogaghna, shothaghna, garbhaashayashodhani, aruchihara, vamanashamani, agnimaandyahara, ajeernaghna, jeerna-jwarahara.*

**Medicinal properties and uses :** The fruits are stomachic, carminative and lactagogue (Nadkarni, 1954).

**Pharmacognosy :** Fruits of *C. bulbocastanum* have been used as a substitute for those of *C. carvi* in India. Fruits have separate, oblong semi-terete dark brown mericarps, 4 to 7 mm. long and have intense aromatic odour and taste.

Seeds are characteristic of umbelliferous fruits consisting of testa, endosperm and embryo. The distinguishing characters of *C. bulbocastanum* and *C. carvi* are described in Table I (Shah and Khanna, 1965).

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**Table I.**

| *C. bulbocastanum* | *C. carvi* |
|---|---|
| Fruits smaller and darker | bigger and lighter |
| Two ventral vittae smaller than dorsal vittae | dorsal and ventral vittae of same size |
| Carvone and limonene absent in volatile oil | Present in volatile oil |

*C. gracile* has been considered to be the major component of the majority of 'Jeera' samples. The pharmacognostic characters of *C. gracile* and *C. carvi* have been differentiated (Table II).

**Table II.**

| | *C. carvi* | *C. gracile* |
|---|---|---|
| 1. | Fruits larger in size and compressed laterally | Smaller in size and dorsally sub-compressed |
| 2. | Epicarp cells have a thick striated cuticle | Epicarp cells have a thin cuticle |
| 3. | Small schizogenous canals present on the outer margin of the vascular strand extending in both stylopod and the pedicel | Schizogenous canals absent |
| 4. | Cells of the endocarp thin walled, subrectangular and tangentially elongated | Cells of endocarp collapsed |
| 5. | Vascular bundle consists of an inner group of small vessels and fibres and an arched outer group of sclerenchyma | Vascular bundle consists of two collateral strands, separated by a group of sclerenchymatous cells |
| 6. | Calcium oxalate crystals are small, abundant and aggregated | Isolated, prism shaped crystals of calcium oxalate present |
| 7. | Cells of endosperm have two microrosette crystals of calcium oxalate | Crystals prism-shaped |

An examination of several samples of commercial 'Jeera' revealed that all the samples represent a mixture of two or more fruits of different botanical origin (Dutt *et al.*, 1972).

**Chemistry :** From the physico-chemical constants, the oil obtained from *Carum carvi* of Lahaul was found to be of superior quality. The presence of carvone and limonene was demonstrated by isolation of these constituents by fractionation and preparation

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of suitable derivatives. G.L.C. study showed that carvone and limonene constituted the major bulk of the oil, the other constituents were present in very minor proportions. The yield of oil from Lahaul caraway was 5-7 per cent and the carvone content was 63·3 per cent, the pharmacopoeial standard being 53 per cent (Atal and Sood, 1967).

**Pharmacology :** The essential oil and total oils of *C. copticum* caused a marked fall in blood pressure of cats. These oils and the glycosidal fraction produced nonspecific spasmogenic action on isolated ileum, tracheal chain and bronchial musculature of cats (Mukherjee *et al.*, 1967).

A decoction of *C. coptis* decreased the faecal output in rats. It had a relaxant action in small doses and stimulant action in large doses on isolated parts of rat alimentary tract. The constipation caused by the drug was probably due to its spasmodic action (Haranath and Devasankariah, 1972).

The alcoholic extract of the fruits of *C. roxburghianum* was found to have CNS depressant activity in mice. The extract also showed anti-protozoal activity against *Entamoeba histolytica* (Dhar *et al.*, 1968).

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# CASSIA (Leguminosae)

*C. ABSUS* Linn.

Hind. — Chaksu
Mal. — Karinkolla
Mar. — Chaksie
Tam. — Mulaippal-virai
Tel. — Chanupalavittulu

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**Habitat :** A tree found throughout India.

**Parts used :** Leaves and seeds.

**Ayurvedic description**

Sanskrit : *Kulatthika*

Synonyms : *Vanyakulatthtika, chakshuya, aranyakulatthtika*

Properties : *Rasa* — *Katu, kashaaya, tikta*
*Guna* — *Rooksha*
*Veerya* — *Ushna*
*Vipaaka* — *Katu/amla*

Actions/Uses : *Arshaghna, shoolanaashanee, vibhandashamanee, aadhmaanashamanee, vranaropanee, balya*

**Medicinal properties and uses :** The leaves are bitter and used as astringent. It is also considered to be a cough remedy. The seeds are also astringent; used in ringworm and other skin affections, in conjunctivitis and ophthalmia (Chopra *et al.*, 1956).

*C. ANGUSTIFOLIA* Vahl.

Ben. — Sonamukhi
Hind. — Hindisana
Mal. — Nilavaka
Mar. — Sonamukhi
Tam. — Nilavakai
Tel. — Nelatangedu

**Habitat :** Cultivated in south India.

**Parts used :** Leaves and fruits.

**Medicinal properties and uses :** Used as laxative and purgative (Chopra *et al.*, 1956; Nadkarni, 1954).

*C. AURICULATA* Linn.

Hind. — Tarwar
Mal. — Avaram
Mar. — Tarwad
Tam. — Avaram
Tel. — Tangedu

**Habitat :** Grows wild in dry regions of Madhya Pradesh, west Peninsula and Rajputana. Cultivated in other parts of India.

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**Parts used :** Bark, root, leaves, fruits and seeds.

**Ayurvedic description**

Sanskrit : *Aavartakee*

Synonyms : *Peetapushpa, peetakaalika, charmaranga*

Properties : *Rasa* — *Tikta, kashaaya*
*Guna* — *Laghu, rooksha*
*Veerya* — *Sheeta*
*Vipaaka* — *Katu*

Actions/Uses : General—*Mukharookshamana, kushtaghna, kandooghna, jantughna, shoolaapaha, vranaapaha*
Flowers—*Pramehashamana*
Tender fruits—*Vameehara, krimihara, sarvapramehaapaha, trishnaghna, akshihita, ruchyam*
Seeds—*Madhumehaghna, vishahara, raktaateesaarshamana*
Root—*Trishnahaara, pramehaghna, shwaasaghna, raktapittashamana, shukrakshayepoojitam.*

**Medicinal properties and uses :** The bark and roots are astringent. The roots are used in skin diseases while the leaves and fruits are anthelmintic. Seeds are used in ophthalmia and conjunctivitis as also in diabetes and chylous urine (Chopra *et al.*, 1956; Nadkarni, 1954).

*C. FISTULA* Linn.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Bundarlati | Kon. | — | Kakkayi |
| Eng. | — | Indian Laburnum, purging cassia | Mal. | — | Konna |
| Guj. | — | Garmala | Mar. | — | Bahava |
| Hind. | — | Sonhali, amulthus | Tam. | — | Sharakkonnai |
| Kan. | — | Kakkemara | Tel. | — | Kondrakayi |

**Habitat :** Common throughout India and Burma.

**Parts used :** Fruit pulp, root-bark, flowers, pods, leaves and root.

**Ayurvedic description**

Sanskrit : *Aaragwadha*

Synonyms : *Suvarnaka, raajavriksha, kritamaalaka, shampaaka, chaturangula, aarevata, deerghaphala, karnikaara, vyaadhighaata, pragraha, swarna bhooshana*

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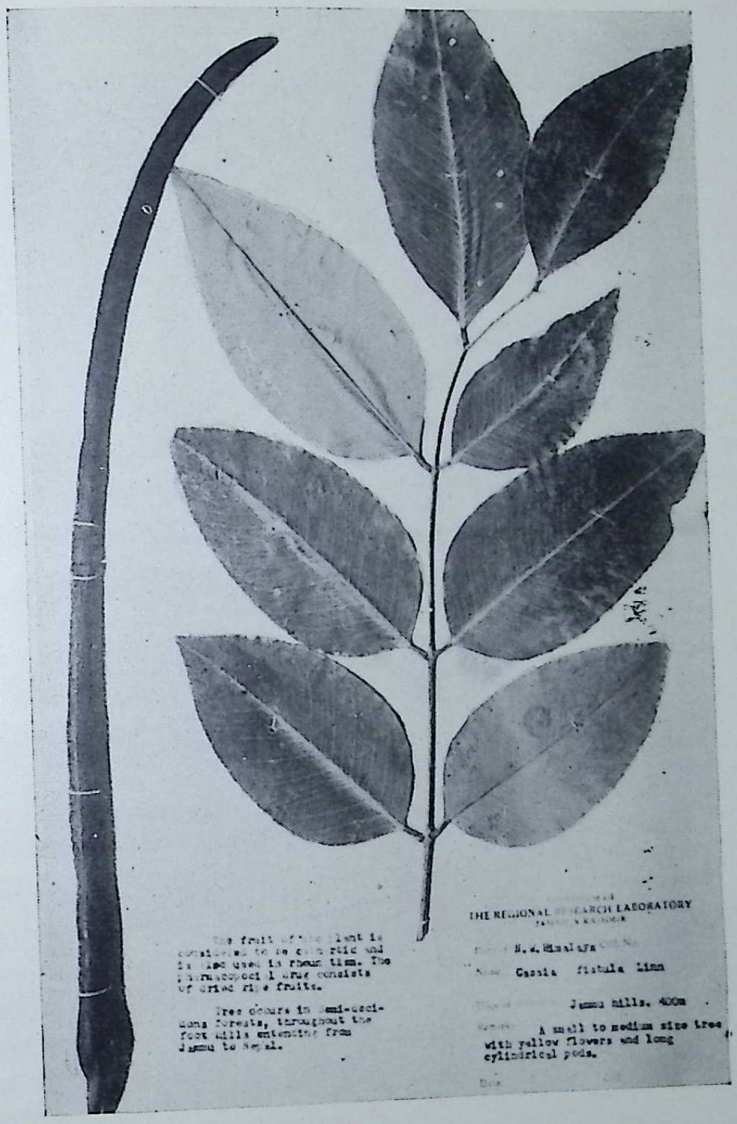


*Cassia fistula*

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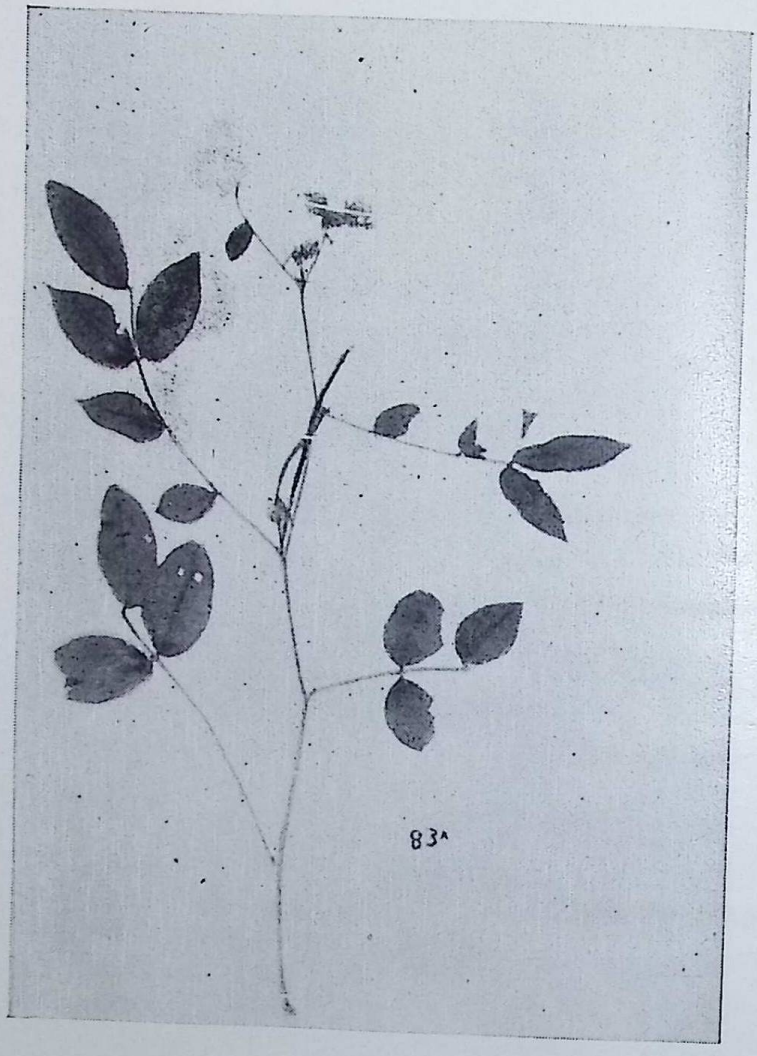


*Cassia occidentalis*

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Properties : *Rasa* — *Madhura, tikta*
*Guna* — *Guru, mridu, snigdha*
*Veerya* — *Sheeta*
*Vipaaka* — *Madhura*

Actions/Uses : *Krimighna, shoolaghna, kaphodarahara, pramehaghna, gulmahara, jwarahara, kandoohara, kushtahara, vishtambhaghna, hridrogaghna, raktapittahara, udaavartaghna, shoolahara, shothahara, vedanaasthapana.*

**Medicinal properties and uses :** Pulp, root-bark, seeds and leaves have purgative properties and are also used as tonic and febrifuge. Fruit is also cathartic (Nadkarni, 1954).

*C. JAVANICA* Linn.

**Habitat :** In French Guiana it has been used as a substitute for *C. fistula.* Planted in Calcutta and Bombay.

*C. MIMOSOIDES* Linn.

Tel. — Nelaponna.

**Habitat :** Found throughout India.

**Parts used :** Roots.

**Medicinal properties and uses :** Roots are used in spasms of stomach (Chopra *et al.*, 1956; Nadkarni, 1954).

*C. OCCIDENTALIS* Linn.

Ben. — Kalakasunda
Eng. — Negro coffee
Guj. and Mar. — Kasuvayee
Hind. — Kasondi
Kan. — Doddatagache
Kon. — Hodu-taikilo
Mal. — Natrum-takara
Tam. — Poonaavarai
Tel. — Kasinda

**Habitat :** A common weed scattered from Himalayas to west Bengal, south India, Burma and Ceylon.

**Parts used :** Leaves, seeds and roots.

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**Medicinal properties and uses :** Leaves, roots and seeds have been found to be purgative. Seeds are also febrifuge. Roots have been considered as diuretic and antiperiodic (Nadkarni, 1954).

*C. SOPHERA* Linn. (Syn. *C. coromendeliana* Jacq.)

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Kalakasunda | Mar. | — | Ran-tankala |
| Eng. | — | Senna sophera | Tam. | — | Shuulavarai |
| Hind. | — | Bas-ki-kasunda | Tel.. | — | Paidi-tangaedu |
| Mal. | — | Ponnantakara | | | |

**Habitat :** Common throughout the tropical region of India.

**Parts used :** Bark, leaves, seeds, root and root-bark.

**Ayurvedic description**

Sanskrit : *Kaasamarda*

Synonyms : *Arimarda, kaasaari, karkasha*

Properties : *Rasa* — *Madhura, tikta*
*Guna* — *Laghu*
*Veerya* — *Ushna*
*Vipaaka* — *Katu/madhura*

Actions/Uses : *Graahaka, paachana, ajeernahara, kaasahara, ruchya, vrishya, visnahara, kanthashodhaka*

**Medicinal properties and uses :** Bark, leaves and seeds are cathartic whereas the root is an expectorant. Leaves are anthelmintic and antiseptic (Nadkarni, 1954).

*C. TORA* Linn. (Syn. *C. toroides* Roxb., *C. foetida* Pers, *C. obtusifolia* Linn.).

| | | | | | |
|---|---|---|---|---|---|
| Eng. | — | Foetid Cassia | Mal. | — | Takara |
| Guj. | — | Koyaraya | Mar. | — | Tankala |
| Hind. and Ben. | — | Chakunda | Tam. | — | Tagarai |
| Kon. | — | Daddupan | Tel. | — | Tagirisa |

**Habitat :** A small plant growing on dry soil in Bengal and throughout the tropical parts of India.

**Parts used :** Leaves, seeds and roots.

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**Ayurvedic description**

Sanskrit : *Chakramarda*

Synonyms : *Dadrughna, meshalochana, chakrika, edagaja, prapushpa, mardaka, padmaata, meshakusuma, prapunnaata*

Properties : *Rasa* — *Madhura, katu*
*Guna* — *Laghu, rooksha*
*Veerya* — *Ushna*
*Vipaaka* — *Katu*

Actions/Uses : General—*Lekhana, kushtaghna, vishaghna, krimighna, hridya, kaanti-soukumaaryakara, medoghna, shrishtavinmootrahara*
Branch—*Kushtaapaha, balya, dadrupaamaahara*
Fruit —*Vishaghna, kandooghna, gulmahara, dadrughna, shwaasahara, kaasahara, krimihara, sidhmahara.*

**Medicinal properties and uses :** Mucilagenous and foetid smelling leaves have been found to be internally gentle aperient and externally used as germicide and antiparasitic. They have anodyne action. Root and seeds have also the same properties externally (Nadkarni, 1954).

**Pharmacognosy :** Macro and microscopic characters of the leaves of *C. fistula* have been studied. The leaflets are 4-8 pairs and when fresh are coriaceous and on drying they become papery. Unicellular, non-lignified, pointed trichomes are present on upper epidermis. Spongy parenchyma contains large prismatic crystals of calcium oxalate. Stomata are absent on the upper epidermis. Transection through midrib shows a layer of epidermal cells with pointed trichomes. A group of bundles is also seen in the centre of the midrib. Rest of the midrib is occupied by thin walled parenchymatous cells, some of which contain prismatic crystals of calcium oxalate and others contain starch grains (Chaudhuri and Kayal, 1969).

The leaves of *C. fistula* are dorsiventral in transection, with 2-3 rows of palisade cells below the epidermis. The upper epidermis possesses unicellular, non-lignified long, coiled trichomes being more near the midrib. The lower epidermis has unicellular warty, dagger-shaped trichomes. The lower epidermal cells are papillose. Stout prisms of calcium oxalate are present, only few clusters are seen. The midrib possesses an arc of radiate xylem followed by phloem. The pericyclic fibres form a complete circle, enclosing two separate inverted vascular bundles above the normal xylem. The stomatal index, palisade ratio and vein-islet number are different from the other species of *Cassia* (Rao and Ali, 1970).

The macro and macroscopic characters of the leaves of *C. sophera* have also been studied. The leaflets are 5-10 pairs, apparently glabrous. Unicellular pointed-head trichomes are present throughout the margin of the leaves in length and measure 121·6-254.6 μ in length. In the spongy parenchyma cells, rosette crystals of calcium oxalate

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are present. Rubiaceous stomata are present throughout the leaf. The leaf powder, when examined under the microscope, shows the presence of small fragments of leaflets, epidermal cells and palisade cells with a few spongy parenchymatous cells, vascular elements, isolated pointed-head trichomes and rosette crystals of calciumoxa late (Chaudhari, 1964).

The root, stem and leaf of *C. tora* have also been studied. It is an annual herb with an erect stem and compound leaves but does not have a well developed tap root system. Young root in transverse section shows single layered epidermis followed by cortex, endodermis and pericycle enclosing a diarch stele. Mature root shows phelloderm of 8-12 layers of parenchymatous cells. Crystals of calcium oxalate of rosette and prismatic type are present in phelloderm parenchyma. The secondary phloem shows sieve tubes, companion cells and phloem parenchyma. The wood is composed of vessels, tracheids, fibres, medullary rays and some parenchymatous cells. In young stem, cortex contains rosette of small prismatic crystals of calcium oxalate. Vascular bundles are of collateral type.

In the mature stem tanniniferous contents occur in cork and outer phelloderm. The narrow medullary rays have some prismatic crystals (Prakash and Prasad, 1971).

Cuticular characters by which 6 species of *Cassia* namely *C. alata*, *C. auriculata*, *C. occidentalis*, *C. siamea*, *C. sophera*, and *C. tora* can be distinguished even if small fragments of materials are available, have been described. Stomata in all the species are of rubiaceous type but their occurrence on one or both the surfaces of the leaf, the size of the subsidiary cells in comparison with guard cells, and the nature of the epidermal cells and the hairs are the distinguishing features (Pandey, 1969).

**Chemistry :** Two new anthraquinone pigments, having m.p. 232° and m.p. 180° and β-sitosterol were isolated from the roots of *C. alata*. The structures of these pigments have also been established (Tiwari and Yadava, 1970).

Fractional precipitation and chromatographic studies have shown that the pods of *C. angustifolia* contain besides sennosides A and B, glycosides of rhein and chrysophanic acid. Chrysophanic acid was best isolated by acidification of the aqueous extract to pH 3. Biologically, a mixture of these anthraquinone glycosides and the bianthranol glycosides was more active than either individually. The possibility of the presence of traces of a aloe-emodin or emodin glucoside was also indicated (Khorana and Sanghavi, 1964).

The development of free and combined anthraquinones in *C. angustifolia* was studied during growth. Colorimetric method was employed and it showed the formation of free anthraquinones in 72 hours and formation of glycosides in a week-old seedling (Dane *et al.*, 1972).

The aqueous extract of the leaves of *C. fistula* was fractionated by precipitation with an acid. Glycosides were purified through acetone and finally identified as

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sennoside A and sennoside B by chromatographic studies. A seasonal variation was found to occur in the glycosidal content of leaf (Kaji and Khorana, 1964).

The lead precipitate of the aqueous extracts of *C. fistula* (pod pulp) was decomposed with oxalic acid in aqueous acetone. Dried residue was extracted with methanol and precipitate was obtained with calcium chloride at different pH. The precipitates at pH 5-6 contained rhein glucoside identified by chromatography and co-chromatography after hydrolysis (Kaji *et al.*, 1965).

Ceryl alcohol, kaempferol, rhein and a new biantbraquinone glycoside, fistulin were isolated from the ethanolic extract of the flowers of *C. fistula*. IR spectra of fistulin suggested it to be an anthraquinone having a free carbonyl group (Kumar *et al.*, 1966).

The bark and heartwood of *C. fistula* were found to contain fistucacidin, an optically inactive leucoanthocyanidin, 3, 4, 7, 8, 4'-pentahydroxyflavan along with barbaloin and rhein (Murty *et al.*, 1967).

Leaves of *C. fistula* have been found to contain free rhein, rhein glucoside, sennoside A and sennoside B. While rhein and its glucoside could be isolated in pure state, others were isolated in a mixture form. They were identified by comparison of Rf values, U.V. maxima and I.R. spectra and the products of hydrolysis. Observations were also made on the active constituents in plants during different seasons (Kaji *et al.*, 1968).

N-butanol extract of powdered stem bark of *C. fistula* contained tannins. The benzene extract yielded lupeol, β-sitosterol and hexacosanol (Sen and Shukla, 1968).

Chemical examination of *C. fistula* pods led to the isolation of a new anthraquinone named fistulic acid from the alcoholic extract. The structure of fistulic acid was tentatively assigned as 1, 4-dihydroxy 6, 7-dimethoxy-2-methylanthraquinone-3-carboxylic acid, on the basis of elemental analysis, IR, UV spectra, acetylation, colour reactions *etc.* (Agarwal *et al.*, 1972).

The flowers of *C. fistula* have been found to give kaempferol in acetone extract and a proanthocyanidin whose structure has been established as a leucopelargonidin tetramer having a free glycol unit. The bark, on similar extraction, yielded a leucopelargonidin trimer with no free glycol unit. The methanol extract of both the materials contained, besides higher polymers of propelargonidin, a small amount of rhein as glycoside (Narayanan and Seshadri, 1972).

A colorimetric estimation of *C. javanica* leaves showed 0·25 to 0·4 per cent of free anthraquinones and 1·3 per cent of combined anthraquinones. This sample of leaves contained no sennosides (Khorana and Kaji, 1965).

From the ethanolic extract of the flowers of *C. javanica*, four flavonoid glycosides were isolated and characterised. They were leucocyanidin-4'-O-3-methyl ether -3β-D-galactopyranoside, dihydrorhamnetin, 3-0-α-L-rhamnopyranoside, kaempferol

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and 3-rhamnoglucoside. In addition, quercetin was also obtained (Tiwari and Yadava, 1971).

The roots of *C. mimusoides* contained physcion and no flavonoid and the seeds contained luteolin and its 7-glucoside, emodin, physcion and emodic acid (Subramanian and Nagarajan, 1970).

Nodosin, isolated from the flowers of *C. nodosa*, was determined quantitatively in micro amounts (Rai *et al.*, 1971).

Chemical and spectral studies of the flowers of *C. nodosa* resulted in the isolation of a new anthraquinone glycoside from the alcoholic extract provisionally named as nodososide. Acid hydrolysis of the compound gave D-glucose and an aglycone, nodosin. On the basis of elemental analysis, IR and UV spectra, acetylation, colour reactions, oxidation with nitric acid and alkaline potassium permanganate, caustic potash fusion, zinc dust distillation and bromination, the structure of nodosin has been established as 1, 3, 5, 8-tetrahydroxy-2, 7-dimethylanthraquinone (Rizvi *et al.*, 1971).

Extractives of *C. occidentalis* furnished in addition to emodin and physcion, two unidentified pigments having m.p. 214-216° and 243-245°; chrysophanol ; α-3-sitosterol and a new xanthone, cassiollin, identified as 1, 7-dihydroxy-5-methoxy-carbonyl-3-methylxanthone (Ginde *et al.*, 1970).

From the light petroleum extract of trunk-bark of *C. siamea* a neutral compound has been isolated. It crystallised from ethanol in needles m.p. 170°, analysed for $C_{20}H_{48}O$ and was found to be a triterpenoid. This ketonic compound on sodium borohydride reduction furnished an alcohol, $C_{30}H_{50}O$ which crystallised from aqueous ethanol in needles, m.p. 211-12°. The identity was established by mixed melting point determination and from superimposable IR spectra, proving the ketonic compound to be lupenone (Chatterjee *et al.*, 1966).

A chromone was isolated from *C. siamea* flowers and its structure elucidated from spectral and chemical data (Arora *et al.*, 1971).

Seeds of 'Panwar' (*C. tora*) yielded 7·65 per cent gum which gave highly viscous mucilage at even low gum concentrations. Value of this gum was enhanced by the pH of mucilage which was about 7 (Joshi and Varma, 1962-1964).

'Panwar gum' has been found to be most efficient suspending agent, for calomel, heavy kaolin and talc, followed by guar ghatti and acacia gums. Although 'panwar' and guar gums give highly viscous emulsions with olive oil, liquid paraffin and turpentine oil, they had a greater tendency to cream and the frequency of smaller particles in them was less as compared to those of acacia and ghatti (Joshi and Varma, 1964).

Tablets of lactose, sodium bicarbonate and sulphanilamide were prepared using mucilages of Panwar (1 per cent), starch (10 per cent), acacia (10 per cent) and guar (1 per cent). Tablets were studied for hardness, disintegration time, uniformity in weight and compared with those prepared with starch, mucilage, acasia and guar as binding agents.

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The results indicated that 'panwar gum' was a satisfactory binding agent even at low gum concentration (Joshi *et al.*, 1964).

A chemical examination of the ash of the stem and leaf of *C. tora* showed the presence of sulphate, phosphate, calcium, iron, magnesium, sodium and potassium (Sastry, 1965).

The seeds of *C. tora* and *C. occidentalis* were found to contain rhein, aloe-emodin and chrysophanol as indicated by TLC studies (Shah and Shinde, 1969).

Seeds of *C. angustifolia*, *C. auriculata*, *C. fistula*, *C. laevigata*, *C. siamea*, *C. sophera* and *C. tora* were also examined for their sterol content. The sterol from *C. siamea* has been identified as α-sitosterol. In all other cases the sterol isolated was found to be β-sitosterol (Chakaravarti *et al.*, 1955, 1956).

The leaves of *C. tora* and *C. occidentalis* were found to differ in their chemical nature. Chrysophanol, aloe-emodin, rhein and emodin were found to be present, though the amount varied in the two species, being less in *C. occidentalis* (Shah *et al.*, 1968).

Studies on the leaves of *C. nodosa*, *C. grandis* and *C. ranigera* showed the presence of one or more anthraquinone derivatives like rhein, aloe-emodin and chrysophanic acid both in free and combined states. The rhein glucoside and its aglycone were isolated in pure state from *C. nodosa*. In other species, presence of anthraquinone derivatives was confirmed by chromatography and IR spectra. These studies also revealed the presence of bianthranol glucosides namely sennosides A and B. The total amount of these glucosides present in each case was very poor, being of the order of 0·01 per cent to 0·03 per cent. Presence of rhamnoglucoside was also indicated in all the cases. The aglucone was probably flavonol (Kaji, 1968).

The structure of a new pigment cassiamin, from *C. siamea* and some other plants has also been worked out (Dutta *et al.*, 1964).

**Pharmacology :** Chaksine, an alkaloid isolated from the seeds of *C. absus* produced a fall in blood pressure, mainly by dilatation of capillaries in anaesthetized cats and dogs. The fall could be prevented by pretreatment with antihistaminics. It stimulated the respiration of cats and dogs. It also stimulated the contractions of uterus, intestines, bladder and musculature of the blood vessels. It depressed the parasympathetic nerve endings of intestines and bladder, the action being similar to that of atropine. It had a weak curariform activity. Maximum lethal dose in rats (intraperitoneally) was found to be 70 mg./kg. approximately (Pradhan *et al.*, 1953).

The aqueous extract of the seeds of *C. auriculata* produced a 15-25 per cent fall in the blood sugar of normal and alloxan diabetic rabbits and dogs within 4-5 hours after giving a single oral dose (Shrotri *et al.*, 1963).

The aqueous extracts of leaves, stem bark, root bark and fruit pulp of *C. fistula* in a dose of 1 g./100 g. body weight produced significant anti-inflammatory effect on

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albino rats. The root bark had the maximum activity which could probably be attributed to the presence of flavonoids that are known to decrease capillary permeability by a direct vasoconstrictor action on vessels (Lillykutty, 1968).

The aqueous extract of the fruit pulp had very little effect on arterial blood pressure of anaesthetized dogs and cats. But it caused an inhibitory effect on the isolated hearts of frog and rabbit. At a dose of 80 mg. and above, it exhibited stimulant effect on smooth muscle of rabbit duodenum and guineapig ileum *in vitro*. The extract had a relaxant effect on the dog's intestine *in vivo*. On isolated rat uterus, the extract had slight stimulant action in doses of 25 mg. to 1 g. (Lillykutty, 1968).

*C. fistula* has been found to possess significant antipyretic and analgesic properties (Patel *et al.*, 1965).

The aqueous extract of the fruit pulp had significant purgative action. In a dose of 250 mg. and above, it caused purgative action that reached maximum in 6-9 hours and lasted for 24 hours. The purgative activity was attributed to the anthraquinones present (Lillykutty, 1968).

The sugar-free residue from the pulp of *C. fistula* has been found to possess cathartic property in mice which was more than that of the total pulp. The minimum effective dose was 12 mg. per mouse weighing 20 grams. The cathartic property of the pulp was compared with that of Senna (Iyengar *et al.*, 1966).

The leaves, stem bark and fruit pulp of *C. fistula* were found to have antibacterial activity, the fruit pulp being the most potent in this respect. The solvent ether fraction of fruit pulp had maximum activity against *S. aureus*, *S. albus*, *B. megatherium*, *S. flexneri*, *S. shigae*, *S. typhi* para A and B and 1 g. of this extract was more potent than 100 µg. of chloramphenicol *in vitro*. The activity was attributed to the presence of rhein. The actone extracts of root bark and stem bark had antifungal activity against *M. tonsurans*, *T. rubrum* and *T. megninii*. The root bark had the maximum activity, 100 mg. of it being more potent than 16 µg. of griseofulvin *in vitro*. The activity might be due to the presence of flavonoids (Lillykutty and Santhakumari, 1969).

The antifungal activity of *C. fistula* was further confirmed by studies on the flavonoidal glycosides isolated from the acetone extract of the root. Out of the five glycosides tested, *CFRI* (one of the glycosides) alone exhibited marked antifungal activity. The activity was completely lost on blocking the free hydroxyl groups of the active flavonoid glycosides (Venkitaraman and Radhakrishnan, 1972).

Out of the various fractions of the roots of *C. occidentalis*, the alcohol-ether soluble fraction (100 mg.) gave good diuretic response (about 300 per cent rise in urine volume rate over control) in anaesthetised and hydrated dogs (Bhide and Sheth 1957).

The petroleum ether, benzene and alcoholic extracts of seeds, leaves and roots of *C. occidentalis* had an antibacterial activity against *S. aureus*, *B. subtilis*, *B. proteus* and *V. cholerae*. The antibiotic activity was found to be due to the essential oil present in the plant (Gaind *et al.*, 1966).

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The alcoholic extract of the leaves of *C. sophera* produced relaxation of the intestinal and bronchial musculature of guineapig. The effect was nonspecific and probably due to direct action on the musculature (Murthy and Sirsi, 1958).

The alcoholic extracts of the roots and aerial parts of *C. auriculata*, pods and stem bark of *C. fistula* and entire plant of *C. tora* were found to have antiviral activity against *Ranikhet disease virus* and *vaccinia virus*. In addition, the extracts of *C. fistula* also possessed hypoglycaemic activity in albino rats (Dhar *et al.*, 1968).

The efficacy of *Cassia species* in skin diseases may be attributed to the presence of anthraquinone derivatives specially chrysophanol, which were the active constituents of Goa powder, a remedy for skin diseases (Shah *et al.*, 1968).

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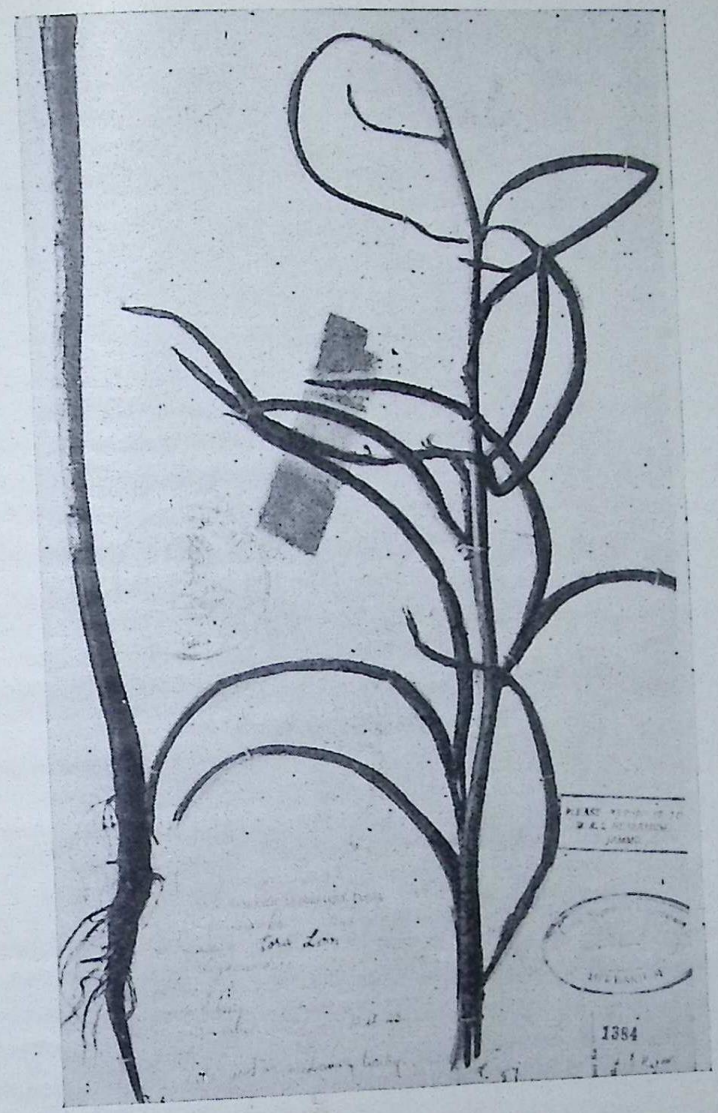


*Cassia tora*

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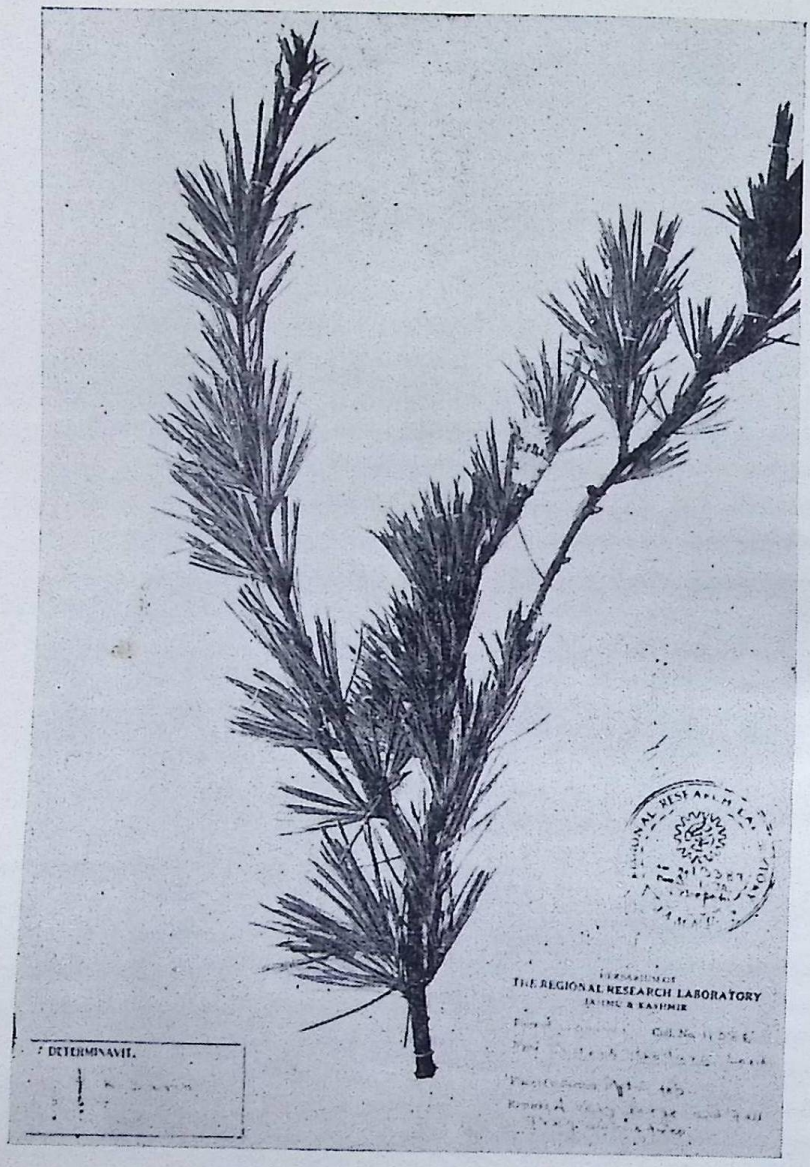


*Cedrus deodara*

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## CATHARANTHUS (Apocynaceae)

*C. PUSILLUS* (Murr.) G. Don. (Syn. *Vinca pusilla* Murr., *Lochnera pusilla* K. Scheum.)

Mal. — Kapavila
Tam. — Kapa-vila
Sans. — Sanghaphuli

**Habitat :** Annual herb, indigenous to India, common in western Himalayas, upper Gangetic plain, Bihar, Orissa, Sind, Gujarat, Konkan, Deccan and Karnataka

**Parts used :** Whole plant and leaves.

**Medicinal properties and uses :** Used in lumbago (Chopra *et al.*, 1956 and Nadkarni, 1954).

*C. ROSEUS* (Linn.) G. Don (Syn. *Vinca rosea* Linn., *Lochnera rosea* (Linn.) Reichb. f.)

Mar. — Shadaphul
Tel. — Billa ganneru
Punj. — Rattanjot

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**Habitat :** Plant is a pantropical species originating in Madagascar and spreading to India. Fast growing sub-shrub, woody at the base, commonly grown in Indian gardens.

**Parts used :** Leaves.

**Medicinal properties and uses :** Juice of the leaves is applied in wasp sting. Plant is used as a remedy for diabetes (Chopra *et al.*, 1956).

**Pharmacognosy :** Comparative pharmacognostic studies of the leaves of *C. pusillus* and *C. roseus* have been made.

Macroscopic characters : Leaves of *C. pusillus* are lanceolate with acute apex, glabrous with rough margins and tapering base. Dried leaves are yellowish green and brittle. Leaves of *C. roseus* are oblong or obovate, with an acute base and rounded or mucronate tip. The colour is deep green.

Microscopic characters : Transection of the petiole of *C. pusillus* and *C. roseus* have almost the same anatomical structure. The xylem vessles of the midrib region are less in number and the phloem is not very conspicuous in *C. pusillus* as is seen in *C. roseus*. There are other differences such as :

The palisade cells are smaller in size in *C. pusillus* in comparison to those present in *C. roseus*; half stomata are present in the lower epidermis in *C. pusillus* but absent in *C. roseus*; the palisade ratio is higher in *C. roseus* than that of *C. pusillus*; the number of epidermal cells as well as stomatal number of leaf surface in lower epidermis are lesser in *C. pusillus* than in *C. roseus*; Stomatal index is higher in the lower surface of *C. pusillus* than in *C. roseus*; and the veinlet termination number is also higher in *C. roseus*.

The histological characteristics of the powder of the two species are more or less same. The powder of the leaves of *C. roseus* is deep green and has no taste whereas the powder of *C. pusillus* is yellowish green with a slight bitter taste (Chaudhuri, 1963).

**Chemistry :** The active principle of *V. rosea* was studied. The plant was found to contain 0·85 per cent of total alkaloid in the roots, 0·67 per cent in leaves and 0·31 per cent in stem. Further investigation showed that the total alkaloids have a number of strongly basic and weakly basic components, from which reserpine was isolated and identified using paper chromatographic techniques and spectrophotometric analysis (Bose *et al.*, 1959).

Two important clinically accepted compounds *i.e.* vinblastine and vincristine, and numerous other alkaloids have been isolated from this plant. Studies on monoterpene, sesquiterpene, indole and indoline glycosides have also been done (Bhakuni and Kapil, 1969).

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*Vinca rosea* has gained considerable importance due to the discovery of anticancer activity in its alkaloids*. The average sized roots have 0·13 per cent total alkaloid and the smaller roots (laterals) contain 0·08 per cent (Chandra and Srivastava, 1971).

**Pharmacology :** An alkaloid fraction (V-22) obtained from the alcoholic extract of *V. rosea* caused hypotension in anaesthetised dogs which lasted foı 4-5 hours. It also produced bradycardia which could be counteracted by atropine. It did not block the action of adrenaline or sympathetic ganglion. The fraction also produced sedation in dogs and cats which lasted for 4-5 hours. In general, the activities of V-22 fraction resembled the actions of reserpine (Sheth *et al.*, 1958).

A weakly basic fraction obtained from the plant in a dose of 0·2- 0·4 mg./kg. produced a sustained fall in blood pressure of dogs which was not affected by prior atropinization. A lower dose (0·005-0·04 mg.) depressed the frog heart. At higher doses, it produced acute auricular dilatation and severe arrhythmia. The action was similar to that of reserpine (0·04 mg). Slight bradycardia was observed in dogs. It stimulated the respiration of dogs. In a dose of 2·5 mg./kg., sedation was observed in the dog which was accompanied with myosis and relaxation of the nictitating membrane. The fraction decreased the tone and persistalsis of rat intestine and completely antagonised the acetyl choline-induced contractions. Slight stimulation of rat's uterus was also observed (Bose *et al.*, 1960).

On intraperitoneal administration of the total alkaloids of *V. rosea*, graded degenerative changes in the spermatogenic elements of the testes of male rats were observed. The testes treated with total alkaloids were flaccid and weighed less than those of control rats (Joshi and Ambaye, 1968).

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*Discovery of active anti-neoplastic agents from plants such as *Catharanthus roseus* which are primarily natives of the Indian subcontinent has recently given an impetus for the elaboration of newer and more potent anti cancer drugs for use in modern cancer chemotherapy. Most of the work, however, has been carried out abroad. The *Vinca* alkaloids have been tested against numerous mouse and rat tumours. All the active anti-tumour alkaloids of *C. roseus* appeared to have some capability for arresting mitosis of the mammalian cell *in vitro* and *in vivo*. (Chakraborti, S.K. and Mukherji, B. 1968. Search for anti-cancer drugs from Indian medicinal plants. **J Res Indian Med 3,** 70).

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## CEDRELLA (Meliaceae)

*C. TOONA* Roxb.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Nandibriksha | Mal. | — | Aranamaram |
| Eng. | — | Red Toon or Indian mahogany tree | Mar. | — | Deodari |
| | | | Punj. | — | Khusing |
| Hind. | — | Toona | Tam. | — | Tuunamaram |
| Kan. | — | Devadari | Tel. | — | Nandi-chettu |

**Habitat :** Grows in tropical Himalayas from the Indus eastward and throughout the hilly district of central and southern India.

**Parts used :** Bark, gum and flowers.

**Ayurvedic description**

Sanskrit : *Tooni*

Synonyms : *Nandi, sthooni, nandivriksha, kachchapa, sthoonaka, sthoona, kamtalaka, apeeta (apeena), kuchatunna, kuveraka, kutheraka*

Properties :

| | | |
|---|---|---|
| *Rasa* | — | *Kashaaya, madhura, tikta* |
| *Guna* | — | *Laghu* |
| *Veerya* | — | *Sheeta* |
| *Vipaaka* | — | *Katu* |

Actions/Uses : *Graahi, vrishya, vranaghna, vishaghna, kushtaghna, jwaravegavinaashaka*

**Medicinal properties and uses :** Bark is used as powerful astringent, tonic and antiperiodic. Flowers have been considered emmenagogue. Bark in the form of infusion has been given in chronic dysentery. Powder of the bark has been used for application in various forms of ulceration. With bonduc nut as a tonic and antiperiodic, the infusion has been given in fevers, rheumatism and dysentery. Flowers are given in disorders of menstruation (Nadkarni, 1954).

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**Chemistry :** Geranylgeraniol, $C_{20}H_{37}O$ has been found in the wood of *C. toona* as a free alcohol as well as ester of fatty acids. It was obtained by chromatography of petroleum ether soluble portion of acetone extract of the de-barked trunk wood. The NMR and IR spectrum confirmed the identity as geranylgeraniol (Nagasampagi *et al.*, 1967).

The structure of new sesquiterpene alcohol from the timber of the plant has been studied. The sesquiterpene portion of the wood extractives separated by solvent segregation and column chromatography contained at least 14 components, essentially having about 75 per cent of hydrocarbons; (—) -copaene-farnesane, (—)-alloaromadendrene, (+) -δ-cadiene (—)-calamenene, (+)-α-calacorene, cadalene and 25 per cent of alcohols.

Alcohol I—(cubenol) b.p. 170-180°, analysed for $C_{15}H_{26}O$ bicyclic mono-olefinic tertiary alcohol. Alcohol II—(epi-cubenol) b.p. 170-180°, analysed for $C_{15}H_{26}O$, a monoolefinic tertiary alcohol. Alcohol III—(T-muurolol) m.p. 78·5-80°, analysed for $C_{14}H_{26}O$. Partial synthesis of these alcohols showed more decisive evidences regarding their structure (Nagasampagi *et al.*, 1968).

The seeds of one variety of *C. toona* produced cedrelone $C_{26}H_{30}O_5$, m.p. 208°; 1, 2—dihydrocedrelone $C_{26}H_{32}O_5$, m.p. 216°; bargapten $C_{12}H_3O_4$, m.p. 188-190° and β-sitosterol. Occurrence of 1, 2-dihydrocedrelone; a new tetra nortriterpenoid provided further interesting evidence of the chemotaxonomic feature of Meliaceae family. 1, 2—dihydrocedrelone has been reported to be a hitherto unknown natural product (Chatterjee *et al.*, 1971).

**Pharmacology :** The alcoholic extract of the leaves of *C. toona* was found to have CNS depressant activity in mice. The extract also showed hypoglycaemic activity in rats and antiprotozoal activity against *Entamoeba histolytica* (Dhar *et al.*, 1968).

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# CEDRUS (Pinaceae)

*C. DEODARA* Loud.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Toon | Mal. | — | Devadaru |
| Eng. | — | Pinus deodara, Himalayan cedar | Mar. | — | Devataram |
| | | | Punj. | — | Pahari-keli |
| Hind. | — | Deodar | Tam. | — | Devadaari |
| Kan. | — | Devadaru | Tel. | — | Devdari |

**Habitat :** Found all over northern Himalayas; largely cultivated in India as an ornamental tree.

**Parts used :** Wood, bark and leaves.

**Ayurvedic description**

Sanskrit : *Devadaaru*

Synonyms : *Devakaashta, bhadrakaashta, suradruma, shaanadruhu, daarubhadra, bhadradaru, kurahvaya, surabhooruha, dhoopavriksha, marichapatrala.*

Properties : *Rasa* — *Tikta, katu*
*Guna* — *Laghu, snigdha*
*Veerya* — *Ushna*
*Vipaaka* — *Katu*

Actions/Uses : *Kaasaghna, shwaasaghna, aamadoashahara, hidmanaashaka, jwaraghana, mehaghna, vibandhahara, shophaghna, aadhmaanahara, kandooghna, raktapittashamana, vedaanasthaapana, krimighna, kushtagna, anulomana*

**Medicinal properties and uses :** Wood is a carminative, bark is powerful astringent and febrifuge. Leaves have mild terebinthinate properties (Nadkarni, 1954).

**Chemistry :** The essential oil from the wood of Himalayan Deodar was examined. p-methylacetophenone, p-methyl-$\Delta^3$-tetrahydroacetophenone and atlantone were identified. Two new sesquiterpenes designated as α- and β-himachalene, constitute the major potion of the oil. Himachalol, a new sesquiterpene alcohol related to himachalenes has also been isolated (Krishna Rao *et al.*, 1952).

Isolation and characterisation of pure atlantone has been reported. The minor constituent of the essential oil was shown to be cis-isomer. Intraconversion of the isomers has also been reported (Krishna Pande *et al.*, 1971).

It was reported earlier that from the ether extract of the stem bark, deodarin was isolated and was assigned the structure 3′, 4′, 5, 6-tetrahydroxy-8-C-methyldihydroflavonol (Adinarayana and Seshadri, 1965). As a result of further work, its correct

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constitution was established as 3′, 4′, 5, 7-tetrahydroxy-8-C-methyl dihydroflavonol (8-C-methyl toxifolin) and confirmed by the synthesis of its methyl ether. It was found to be accompanied by a major amount of toxifolin and major amounts of quercetin and 8-C-methyl quercetin (Raghunathan *et al.*, 1971).

**Pharmacology :** The alcoholic extract of the stem of *C. deodara* was found to have anti-cancer activity against human epidermal carcinoma of the nasopharynx in tissue culture (Dhar *et al.*, 1968).

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## CELASTRUS (Celastraceae)

*C. PANICULATUS* Willd. (Syn. *C. montana* Roth., *C. multiflora* Roxb., *C. nutans* Roxb.).

| | | | | | |
|---|---|---|---|---|---|
| Hind., and Guj. | — | Malakanguni | Punj. | — | Sankhu |
| Eng. | — | Staff tree | Sans. | — | Vanhiruchi, kanguni |
| Kan. | — | Kariganne | Tam. | — | Vaalulavai |
| Mar. | — | Kanguni | Tel. | — | Mala-erikata |

**Habitat :** Found in hilly districts, Himalayas and Ceylon.

**Parts used :** Seeds, leaves and oil.

**Medicinal properties and uses :** Oil is rubefacient; seeds are alterative, stimulant and nervine tonic; seeds and oil stimulate intellect and sharpen memory (Nadkarni, 1954).

**Pharmacology* :** The oil obtained from the seeds of the plant produced sedation in rats in a dose of 1 g./kg. intramuscularly. On intraperitoneal administration, the same

*No report available on other aspects.

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dose of oil produced sedation but the effect was not so marked. The oil showed anticonvulsant activity in rats. 50-100 mg./kg. of oil (as emulsion in Tween 80 and water) produced a gradual fall in blood pressure of cats. 20 mg./kg. of the oil produced fall in cardiac output, bradycardia and marked increase in pulse pressure on isolated heart lung preparation (Gaitonde *et al.*, 1957).

An active fraction, designated as Mal III A was isolated from the oil by using counter-current distribution method. This fraction had a tranquillizing effect on rats, mice, monkeys and cats in a dose of 200 mg./kg. It potentiated the effect of hexobarbitone and produced hypothermia in mice. In lower doses, it protected rats against leptozol toxicity and decreased the mortality in grouped mice due to amphetamine. At a higher dose, however, the protection decreased. The fraction also decreased spontaneous motor activity, amphetamine induced hyperactivity and oxygen consumption in mice. Diminution of carotid occlusion reflex and hypotension was observed in anaesthetized cats. Fractions Mal III and Mal III/B produced salivation, vomiting, defaecation and tremors in cats and dogs (Sheth *et al.*, 1963). A polyester prepared from the oil also decreased amphetamine-induced hyperactivity and group toxicity in albino rats. This action, however, was only short-lived (2 hours). The polyester also reduced the rectal temperature in rats (Joglekar and Belwani, 1967).

Aerial parts of the plant were found to possess anti-viral activity against *Ranikhet disease virus* (Bhakuni *et al.*, 1969).

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## CENTELLA (Umbelliferae)

*C. ASIATICA* Urban. (Syn. *Hydrocotyle asiatica* Linn.)

Ben. — Tholkhuri
Hind. — Brahma-manduki
Mar. — Karivana
Tam. — Vallarai
Tel. — Brahmi

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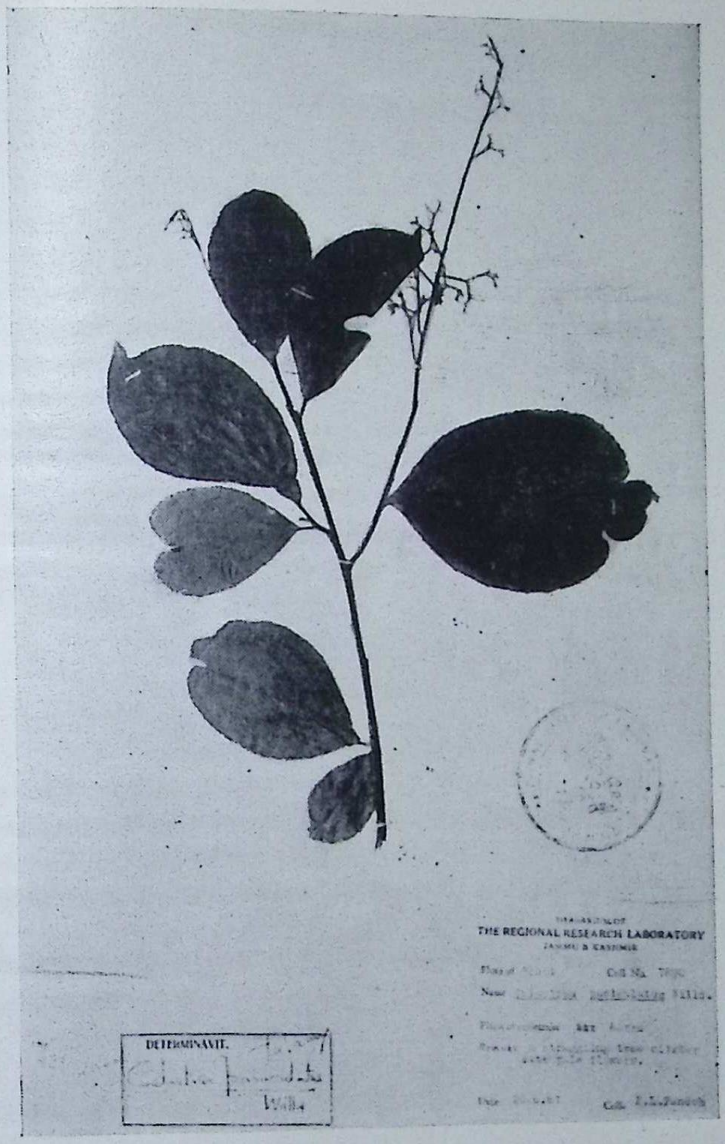


*Celastrus paniculata*

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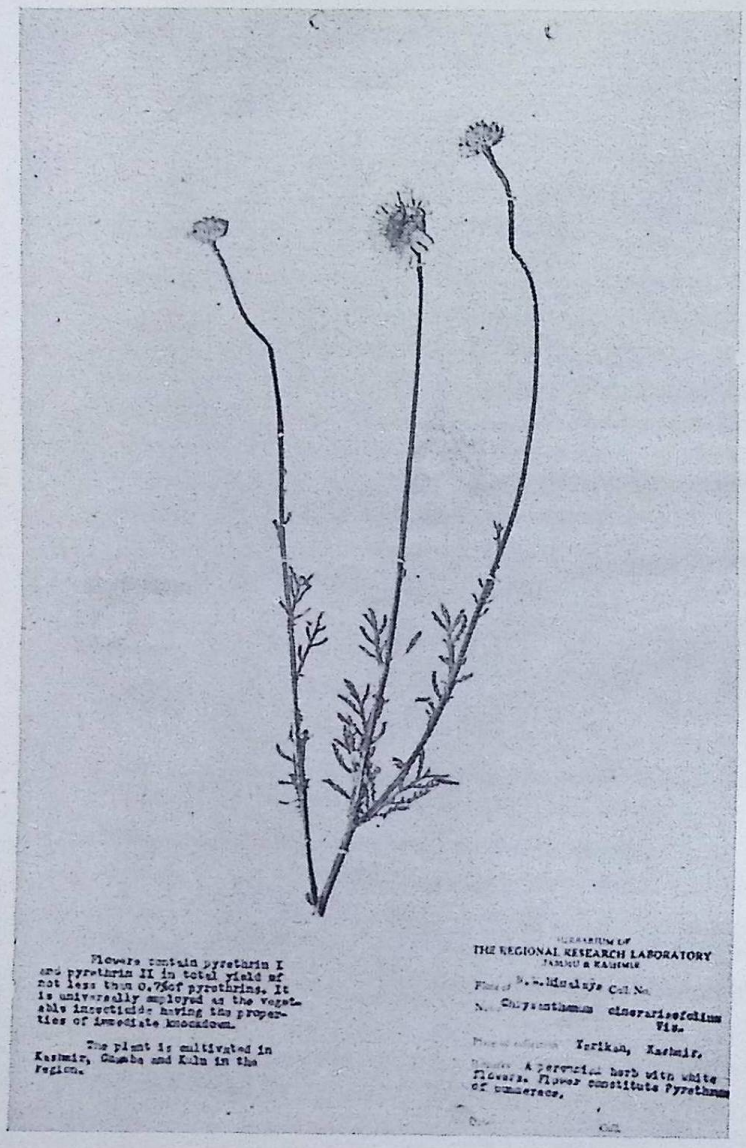


*Chrysanthemum cinerariaefolium*

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**Habitat :** Occurs in wet places as weed, in marshy places throughout the country.

**Parts used :** Whole plant and leaves.

**Ayurvedic description**

Sanskrit : *Mandookaparni*

Synonym : *Mandooki*

Properties : *Rasa* — *Tikta, kashaaya, madhura*
*Guna* — *Laghu, sara*
*Veerya* — *Sheeta*
*Vipaaka* — *Madhura*

Actions/Uses : *Medhya, aayushya, rasaayani, swarya, smrutiprada, agnivardhaka, hridya, varnakara, raktapittaghna, kushtaghna, kandoohara, mehaghna, jwaraghna, shwaasaghna, kaasaghna, aruchighna, vishaghna, shothaghna.*

**Medicinal properties and uses :** The plant has been found to be useful in diseases of skin, nerves and blood. Leaves are used as tonic and for improving memory; useful in syphilitic skin diseases both internally and externally (Chopra *et al.*, 1956; Nadkarni, 1954).

**Chemistry :** The presence of alkaloids, glycosides, sterols, tannins, sugars and inorganic salts has been detected from various extracts of the powdered material. The plant material also contained amino acids *viz.* aspartic acid, glycine, glutamic acid, α-alanine and phenyl-alanine. The total ash contained chloride, sulphate, phosphate, iron, calcium, magnesium, sodium and potassium. The alcoholic extract residue was treated with petroleum ether, ether and chloroform successively and the insoluble mass was taken in water and treated with neutral lead acetate. The lead free filterate when evaporated to dryness gave a brown amorphous glycosidal fraction which, on hydrolysis, yielded an aglycone, corresponding to asiatic acid (m.p. 241°). From the unsaponifiable matter of petroleum ether extract, a phytosterol (m.p. 137°) was isolated which was identified as β-sitosterol. The saponifiable portion gave palmitic and stearic acids. Glucose, potassium chloride and potassium sulphate were also separated from the equeous extract of the plant (Malhotra *et al.*, 1961).

The chemical examination of the plant resulted in the isolation of six constituents in pure state *viz.* two saponins, brahmoside m.p. 242° (decomp.), 0·37 per cent and brahminoside, m.p. 223° (decomp.) 0·16 per cent; two triterpene acids, brahmic acid m.p. 293°, 0·097 per cent and isobrahmic acid m.p. 263°, 0·9 per cent; betulic acid, m.p. 308°, 0·110 per cent and stigmasterol, m.p. 170°, 0·004 per cent. Brahmic acid has been found to be different from indocentoic acid isolated by earlier workers from the Indian variety of the same plant (Rastogi *et al.*, 1960).

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The structures of brahmoside and brahminoside have been found to be tri-and tetra-glycosides respectively of brahmic acid $C_{30}H_{48}O_6$, which was also isolated directly from the plant. The sugar components identified were rhamnose, glucose and arabinose and the most probable arrangement of these could be—$C_{30}H_{47}O_5$-0-rhamnose-glucose-arabinose.

The saponins were found to be different from asiaticoside isolated from the Madagascar variety, and a tentative structure has been proposed for brahmoside. A reliable chromatographic method has also been evolved for the separation of brahmoside and brahminoside from their crude mixture (Rastogi and Dhar, 1963*a*).

Two new glycosides were isolated from the plant and one of them was named as thankuniside, $C_{30}H_{47}O_6$. The identity of the other glycoside was not confirmed. Both the glycosides contained glucose and rhamnose as the sugar residues. Thankuniside on acid or alkaline hydrolysis gave a new triterpene acid, thankunic acid, $C_{30}H_{48}O_6$ (Dutta and Basu, 1962).

A procedure has been evolved to separate two saponins, brahmoside and brahminoside in crystalline state from alcoholic extracts. Hydrolysis of brahmoside gave glucose, arabinose, and rhamnose in equimolar ratio, and a mixture of aglycones. One aglycone was identified as brahmic acid, which has also been extracted directly from the plant. Other aglycone fractions appeared to be particularly dehydrated products of brahmic acid or their derivatives. Similar hydrolytic studies on brahminoside gave glucose, arabinose, rhamnose in molar ratio 2 : 1 : 1 and a major fraction of the aglycone residue was shown to be brahmic acid (Rastogi and Dhar, 1963*b*).

The isolation and identification of asiatic acid from the free triterpene acids of *C. asiatica* has been reported. Asiatic acid has been found to be the main constituent of the plant material from Madagascar (Dutta and Basu, 1967).

The structure of brahmic acid has been worked out with the help of physical, chemical and degradative studies and direct correlation with asiatic acid (Singh and Rastogi, 1968).

Isolation of asiatic acid, asiaticoside, mesoinosital and a new oligosaccharide centellose has been reported from the Indian variety and their relative proportions determined. The periodate oxidation product of asiatic acid has been reinvestigated and the structure has been assigned as a hemiacetal derivative (Singh and Rastogi, 1969).

Studies were carried out with various samples of the plant from different parts of India such as Hardwar, Dehradun, Jammu, Trivandrum, Madras, Hyderabad and Lucknow. Chemical extraction indicated large variation in the yield of saponins depending on the habitat. The samples from Jammu were found to be the richest. Saponins of this plant seem to be of two varieties, the more common one containing asiaticoside and medacassoside, while the less common one was characterised by additional presence of arabinose in the saponins, thus forming brahmoside and brahminoside. The sapogenins and the flavonoid components were the same in both the varieties (Rao and Seshadri, 1969).

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**Pharmacological and clinical studies :** The alcoholic extract produced tranquillising effect in rats. It was found nontoxic upto a dose of 350 mg./kg. intraperitoneally. The alcoholic and aqueous extracts antagonised the barium chloride-induced spasm and reduced spontaneous contraction and also caused relaxation of musculature of isolated ileum of rat. The alcoholic extract was also effective against acetylcholine induced spasm unlike the aqueous extract (Aithal and Sirsi, 1961).

The alcoholic extract was found to have depressant effect in rats in toxic doses. The glycosidal fraction had a sedative effect in rats. It decreased the tone and diminished the amplitude of contractions of isolated ileum of rabbit and albino rat at a concentration of 1 : 2,500 to 1 : 500. In a concentration of 1 : 5,000 to 1 : 500, it produced 5-90 per cent inhibition of acetylcholine-induced spasm in isolated rat's ileum. In anaesthetised dogs, it produced slight respiratory stimulation, hypotension and bradycardia (Malhotra *et al.*, 1961).

Brahmosides were found to possess sedative action in rats equivalent to that of a minor transquillizer. The action appeared to be mainly on the cholinergic mechanism (Ramaswamy *et al.*, 1970).

The alcoholic extract of the entire plant was found to possess anti-protozoal activity against *Entamoeba histolytica* (Dhar *et al.*, 1968).

The effect of the whole plant powder on growth pattern and some biochemical constituents of blood and tissues was studied on albino rats fed on low protein diet (5 per cent) level. The drug prevented the mortality rate due to gross protein deficiency. It increased the blood protein nitrogen and prevented the fatty infiltration of liver (Rajagopalan *et al.*, 1970).

A double blind clinical trial was conducted in 43 normal adults to study the *rasaayana* (anabolic) effect of the drug. It increased the mean level of R.B.C., blood sugar, serum cholesterol, vital capacity and total protein. The increase in the haemoglobin percentage was quite high and statistically significant. The drug also decreased the mean blood urea level and a moderate decrease in serum acid phosphatase was observed (Appa Rao *et al.*, 1967, 1969).

A double blind clinical trial was conducted on 30 mentally retarded children who were free from epilepsy and other neurological conditions, to study the effect of the drug on general mental ability. The results indicated a significant improvement in both general ability and behavioural pattern when the drug was administered for a short period of 12 weeks (Appa Rao *et al.*, 1973).

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## CENTIPEDA (Compositae)

*C. ORBICULARIS* Lour. (Syn. *Myriogyne minuta* Less., *Artemesia sternutatoria* Roxb.)

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Machitta | Guj. | — | Chhikani |
| Eng. | — | Sneezwort | Hind. | — | Nakkchhikni |

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**Habitat :** Found in plains of India and Ceylon.

**Parts used :** Seeds and entire herb.

**Medicinal properties and uses :** The seeds and the powdered herb are used in the form of snuff. It is given in ozaena, headaches and colds; also used in toothache and hemicrania. It has been considered useful in paralysis, pains in joints and as a vermifuge. The infusion of the plant has been found to be very efficient in cases of ophthalmia, purulent or otherwise (Nadkarni, 1954).

**Chemistry* :** Extraction of the powdered whole plant with ether partitioned by benzene-alcohol and concentrates passed through a column of alumina using petroleum ether, benzene and ethyl acetate as successive eluents and subsequent fractional crystallisation, yielded two colourless crystalline substances. The first product was provisionally named Centipeda I and was obtained as colourless needles m.p. 241°. The second product was provisionally named Centipeda II and was purified by chromatography over alumina using petroleum ether both as solvent and eluent. It was finally crystallised from ethyl acetate as colourless needles, m.p. 60°. On reinvestigation, alkaloids, glucosides and saponins were found to be absent in the plant (Rastogi *et al.*, 1953).

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## CEPHAELIS (Rubiaceae)

*C. IPECACUANHA* Brot. Rich (Syn. *Psychotria ipecacuanha* Linn.)

**Habitat :** This is native of Brazil. Cultivated at Mungpoo near Darjeeling and on the Nilgiris specially near Kolar, also at the Rungbee Cinchona plantation in Sikkim. Several species are met with on the hills of both western and eastern ghats.

**Parts used :** Bark and root.

**Medicinal properties and uses :** It is a powerful emetic and is used in amoebic dysentery; as an expectorant and as diaphoretic (Chopra *et al.*, 1956; Nadkarni, 1954).

**Chemistry* :** A simple colorimetric method has been evolved for the estimation of emetine and its tincture in *Ipecacuanha*. The method is based on the formation of

*No report available on other aspects.

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chloroform-soluble coloured complex of emetine and methyl orange at a definite pH, whose colour intensity is proportional to the concentration of emetine within certain limits (Sarin *et al.*, 1959).

Numerous specimens of ipecac roots collected under different conditions were analysed. It was found that plants raised from seeds yielded more roots wherein total alkaloid content as also non-phenolic alkaloids were higher as compared to the plants raised from cuttings.

An increase in the yield of roots of ipecac per plant was also observed with increase of age. Total yield of roots from one year plant was found to be 0·6 g., from two year plant 2·6 g., and from three year plant 9·3 g. The total alkaloid content of the root also increased from preflowering to fruiting stage. The total alkaloid content of roots collected from plants of open beds was much higher than the roots from plants under the shade, but non-phenolic alkaloids were low in the former.

The average total alkaloid content of the secondary root was nearly up to the mark, but the non-phenolic alkaloid was low. Assay of the stem cuttings above the roots showed the percentage of total alkaloids as well as the proportion of non-phenolic alkaloids decreased with the increase in length of stem cutting. The percentage of non-phenolic alkaloids of stem cuttings was always much below 50 per cent. The maximum total alkaloid content of leaves was 1·89 per cent of which 25 per cent was non-phenolic. Roots of *Psychotria erractica*, a wild species of ipecac grown at Rongo were, however, free from alkaloids.

For production of emetine from ipecac roots it was essential to methylate cephaeline, the phenolic alkaloid and convert it to emetine (Chakravarti and Dash, 1966).

Another simple method for the estimation of emetine is based on the formation of a chloroform-soluble coloured complex of emetine with 1 : 2 naphthaquinone-4-sodium sulphonate at a definite pH and temperature, whose colour intensity was proportional to the concentration of emetine within certain limits (Seth and Ray, 1967*a*).

A method was also evolved for the estimation of morphine and emetine in some pharmaceutical preparations (Seth and Ray, 1967*b*).

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# CERBERA (Apocynacea)

*C. ODOLLAM* Gaertn. (Syn. *C. manghas* Linn.)

| | | | |
|---|---|---|---|
| Ben. | — Dabur | Mal. | — Odallum |
| Eng. | — Odallum tree | Mar. | — Sukanu |
| Hind. | — Pilikirbir | Tam. | — Udalai |
| Kan. | — Honde | | |

**Habitat :** Found as salt swamps in Malabar and creeks on the sea coast of India, Ceylon and Laccadives.

**Parts used :** Seeds, bark, leaves, and milky juice.

**Medicinal properties and uses :** Bark, leaves, and milky juice have emetic and purgative properties. Kernel of the seed or fruit is also emetic and purgative. In large doses it is irritant and is used in criminal abortions. In villages the fruit is used in combination with datura seeds in hydrophobia. Fixed oil has been used for anointing the head. The drug has been used as animal poison also (Nadkarni, 1954).

**Chemistry :** The seed kernel of *C. odollam* on extraction with different solvents and fractionation yielded a number of crystalline and amorphous glycosides. The principal crystalline glycosides have been identified as cerberin, neriifolin and thevetin. They were also compared with the glycosides obtained from *Thevetia neriifolia*. There has been great variation in the yield of these compounds. In addition to three crystalline substances, an amorphous, highly water-soluble and intensely bitter fraction was isolated from the plant (Rangaswami and Venkata Rao, 1957).

**Pharmacology :** Cerberin, the active component of the plant, has been found to act both on the rhythm and amplitude producing a positive inotropism in moderate doses and a negative intropic and chronotropic effect in toxic doses. Cerberin first depressed and then stimulated the carotid pressure. It acted as a stimulant on the plain muscle of intestine, the action being similar to pilocarpine (Chopra *et al.*, 1942).

The alcoholic extract of the kernels caused bradycardia on direct application over frog's heart *in situ*. On perfused frog's heart, the amplitude of contractions was found to increase initially while on continuous perfusion there was arrest of the heart in systole. In anaesthetized cats, intravenous administration of the extract in graded doses caused first degree heart block, A-V dissociation, atrial fibrillation and death due to ventricular fibrillation. In anaesthetized dogs, intravenous administration of the extract caused S-T depression, A-V dissociation, ventricular tachycardia and fibrillation. A gradual rise in blood pressure was observed with higher doses in cats and dogs. After administration of β-adrenergic blocking agents, the extract caused bradycardia and death due to ventricular standstill (Kuruvilla *et al.*, 1973).

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## CESTRUM (Solanaceae)

*C. DIURNUM* Linn.

**Habitat :** Cultivated in western India.

**Parts used :** Leaves.

*C. NOCTURNUM* Linn.

Eng. — Lady of night

**Habitat :** Cultivated as an ornamental plant throughout India.

**Parts used :** Leaves.

**Chemistry :** The alcoholic extract of the air-dried leaves of *C. diurnum* has been found to contain alkaloids. A saponin crystallised from aqueous ethanol in minute colourless crystals, m.p. 269° (decomp.), on hydrolysis with aqueous hydrochloric acid, yielded a sapogenin in colourless needles m.p. 204° (Chakravarti and Datta, 1961).

Tigogenin has been obtained in pure form by the hydrolysis of the saponin obtained from the leaves. This compound was found useful as a starting material for the preparation of some steroid hormones having no double bond at 4-5 position like androsterone (Chakravarti *et al.*, 1962*a*).

The saponin from the plant was purified by repeated crystallisation from aqueous alcohol (1 : 4). The pure specimen of saponin bad m.p. 269° (decomp.), and analysed for $C_{56}H_{92}O_{27}$. The results indicated that a molecule of the saponin consisted of one tigogenin molecule attached to xylose molecule through a glucose and a galactose molecule (Chakravarti *et al.*, 1962*b*).

A crystalline product obtained from the ethereal extract of the dried powdered leaves has been identified as ursolic acid (Chakravarti *et al.*, 1963*a*).

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A sapogenin was isolated from the alcoholic extract of the dried leaves of *C. nocturnum*. It had m.p. 242-243° and molecular formula $C_{27}H_{42}O_4$ and it was identified as yuccagenin, which is a comparatively rare steroid sapogenin so far isolated only from *Yucca* species (Chakravarti *et al.*, 1963*b*).

The effect of prolonged action of water on the leaves of *C. nocturnum* containing a mixture of tigogenin and yuccagenin, was studied. Chemical study of the leaves of *C. nocturnum* cut into pieces and kept under water for one month, revealed that both the saponins of the plant undergo hydrolysis to the corresponding sapogenins, but in the case of tigonin, there was always a stereoisomeric change of the sapogenin moiety (Chakravarti *et al.*, 1964).

**Pharmacology :** The saponins of *C. diurnum* and *C. nocturnum* exhibited cardiotonic and cardiotoxic activity. The saponins differed from ouabin in that they did not show emetic property (Roy and Chatterjee, 1968). The alcoholic extract of the aerial parts of *C. diurnum* was found to have CNS depressant action in mice (Bhakuni *et al.*, 1969).

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Roy, A.R. and Chatterjee, M.L. 1968. Pharmacological observations on saponins from *Cestrum diurnum* and *Cestrum nocturnum*. **Indian J Exptl Biol 6,** 160.


## CHAEROPHYLLUM (Umbelliferae)

*C. VILLOSUM* Wall.

**Habitat :** Occurs at an altitude between 1,200-2,000 m. from Kashmir to Sikkim.

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**Pharmacognosy*** : Market samples of *Atis* (*Aconitum heterophyllum*) were found adulterated with a spurious material, identified as roots of *C. villosum* (Sharma *et al.*, 1969). The macroscopic and microscopic characters of the adulterant were investigated and compared with those of the genuine drug.

The roots of *C. villosum* are fusiform, unpaired, dirty grey in colour and have transverse lenticels. They have no crown buds unlike the main drug.

The adulterant could be distinguished microscopically by the presence of secretory canals, absence of endodermis, presence of a single continuous cambial ring and a broad central wood. The distinguishing features of the drug and the adulterant are summarised in the Table below.

| | *Aconitum heterophyllum* | *Chaerophyllum villosum* |
|---|---|---|
| 1. | Roots paired, cylindric to cylindric-oblong or slightly conical | Roots simple, fusifom, never paired. |
| 2. | External surface whitish or grey, less wrinkled. | External surface dirty grey, rough with irregular longitudinal wrinkles and transverse lenticels. |
| 3. | Crown buds present | Crown buds lacking |
| 4. | Taste bitter | Taste initially sweetish followed by an irritating sensation. |
| 5. | Secretory canals absent | Numerous secretory canals found embedded in the cortex and phloem. |
| 6. | Endodermis distinct | Endodermis not distinguishable. |
| 7. | Cambium in the form of 4-8 small isolated rings enclosing individual xylem groups. | Cambium as single continuous wavy ring enclosing the xylary core. |

## Reference

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*No report available on other aspects.

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## CHONEMORPHA (Apocynaceae)

*C. MACROPHYLLA* G. Don. (Syn. *C. fragrans* Moon.)

Ben. — Harki Hind. — Garbedero

**Habitat :** Climbing shrub distributed throughout the moist forests of India, Ceylon, Andamans, Malaya, Indo-China and Phillippines.

**Parts used :** Root bark

**Chemistry*** : Chonemorphine, $C_{23}H_{12}N_2$, a major alkaloid was isolated from the roots and its structure elucidated on the basis of IR, NMR and mass spectral data. The structure was further confirmed by its unambiguous synthesis from deaminooxychonemorphine (Chatterjee and Das, 1967).

Funtumafrine-C, $C_{23}H_{30}NO$, m.p. 168-70° has been isolated from the roots of *C. macrophylla*. It has a been found to be identical with synthetic deaminochonemorphinone. The positive rotations of the two compounds ruled out their possibility of being epimeric (Chatterjee and Banerji, 1972).

### References

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## CHRYSANTHEMUM (Compositae)

*C. CINERARIAEFOLIUM* Trev.

**Habitat :** Cultivated in Kashmir, Nilgiris, north western Himalayas and some other places in India.

**Parts used :** Flowers.

**Medicinal properties and uses :** It is toxic and insecticidal (Chopra *et al.*, 1956). Preparations of flower heads are effective in pediculosis, scabies and against intestinal parasites of animals (Bhagat *et al.*, 1968).

* No report available on other aspects.

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**Chemistry :** The active principles and the flower yield from the plants were studied. Experimental cultivation of pyrethrum in slight acidic soil and in highly acidic soil of sandy nature at Ranikhet showed that the splits transplanted in highly acidic soil produced larger number of flowers per plant and higher total pyrethrin. The active principle (total pyrethrin content) was 0·7 per cent in dried flower heads (Bhagat *et al.*, 1968).

**Pharmacology :** The alcoholic extract of the entire plant *C. leucanthemum* was found to have CNS depressant activity in mice (Dhar *et al.*, 1968).

### References

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## CICER (Pipilionaceae)

*C. ARIETINUM* Linn.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Chot-abut | Mal. | — | Katala |
| Eng. | — | Chicken-pea, Bengal gram | Mar. | — | Harbara |
| Hind. and Guj. | — | Chana | Punj. | — | Nakhud |
| Kan. | — | Kadale | Tam. | — | Kondakkadalai |
| Kon. | — | Chano | Tel. | — | Senagalu |

**Habitat :** Cultivated in Sind, Maharashtra and also grows wild in southern India.

**Parts used :** Seeds and leaves.

**Ayurvedic description**

Sanskrit : *Chanaka*

Synonyms : *Harimantha, sakalapriya*

Properties : *Rasa* — *Kashaaya*
*Guna* — *Laghu, rooksha*
*Veerya* — *Sheeta*
*Vipaaka* — *Katu*

Actions/Uses : *Vishtambhi, raktadoshahara, balya, ruchya, jwaraghna*

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**Medicinal properties and uses :** The plant is refrigerant. Seeds are astringent and antibilious. When roasted, the pulse is considered to be aphrodisiac. Fried seeds are diuretic. The leaf juice is stomachic and laxative (Nadkarni, 1954).

**Chemistry :** To study the composition of amino acids, bengal gram proteins were fractionated into the water soluble, the saline soluble and the alkali-soluble fractions. The proteins were hydrolysed and the amino acids were determined by paper chromatography techniques. The water soluble and potassium hydroxide fractions revealed higher percentage of cysteine, lysine, methionine and tryptophan, while saline fraction was found to be rich in arginine and glutamic acid (Mathur *et al.*, 1968*a*).

In view of the increasing demand for lecithin by the food and pharmaceutical industries, studies were conducted on the feasibility of using bengal gram, which was considered a good source of lecithin, for the production of phosphatides.

A two step extraction procedure was adopted which gave good yield of lecithin along with a highly unsaturated edible oil. In the chemical composition and emulsifying properties, the gram lecithin compared well with imported egg lecithin. The flour left after the recovery of lecithin and unsaturated oil from gram can be utilised for edible purposes, its nutritive value being comparable to that of the original gram. Therefore, the commercial production of lecithin from gram appeared to be feasible (Talwalkar *et al.*, 1969).

**Pharmacological and clinical studies :** *C. arietinum* was found to have highly significant hypocholesterolemic action in rats and rabbits. It not only lowered the total serum cholesterol but also both its fractions *viz.* ester and free cholesterol contents of β-lipoproteins. The hypocholesterolemic property was present in its lipid extract as well as in the defatted portion, the former being more potent in this respect. In rats, the lipid extract was found to be a more potent hypocholesterolemic agent than unsaturated vegetable fats like safflower oil, ground nut oil and mustard oil. Amino-acid analysis of the three protein fractions of *C. arietinum* revealed that the hypocholesterolemic saline-soluble protein differs from the proteins in containing significantly large amounts of arginine and glutamic acid. The hypocholesterolemic action could possibly be attributed to inhibition of synthesis of cholesterol in the liver and increased catabolism and excretion of cholesterol end products in the faeces (Mathur *et al.*, 1964, 1966, 1968*b* and Mathur 1969, 1972).

*C. arietinum* lowered the induced hypocholesterolemia in 16 out of 20 persons during a period of study extending over 67 weeks. The subjects were given "low-fat diet" containing 10 g. of fat for two weeks. They were then fed on a high-fat diet containing 156 g. of butter-fat and supplying 2812 calories daily. After 10 weeks of high fat diet, when the serum lipid levels had become stabilised, they were put on "high fat and *Cicer arietinum* diet" by substituting the latter for wheat flour and other cereals while maintaining the butter fat and total calories at the same level. The studies revealed

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that *C. arietinum* significantly lowered serum lipids. The effect was greatest at the twentieth week of administration of the diet and was maintained throughout the period of study. The hypocholesterolemic effect was associated with a statistically significant increase in 24 hour faecal excretion of total bile acids without any significant increase in neutral or Liebermann-Burchard reacting sterols (Mathur *et al.*, 1968*c*).

*C. arietinum* was found to have a very significant anti-atherogenic effect on rabbits. The atherosclerotic process was delayed in onset and was also less severe in degree in rabbits treated with *C. arietinum*. The advanced atherosclerotic lesions produced by intermittent cholesterol feeding simulated a situation found in case of atherosclerotic involvement of large and medium sized coronary arteries but in the group fed with *C. arietinum* only the small and medium sized blood vesels showed this involvement. The cholesterol content of the aortic wall in the control animals was significantly higher than in the group treated with *C. arietinum* (Mathur, 1972).

The cholesterol lowering property of bengal gram was confirmed by studies on egg yolk-induced hypercholesterolemia in albino rats. This action is ascribed to isoflavone Biochanin-A present in germinating bengal gram (Madhavan *et al.*, 1971).

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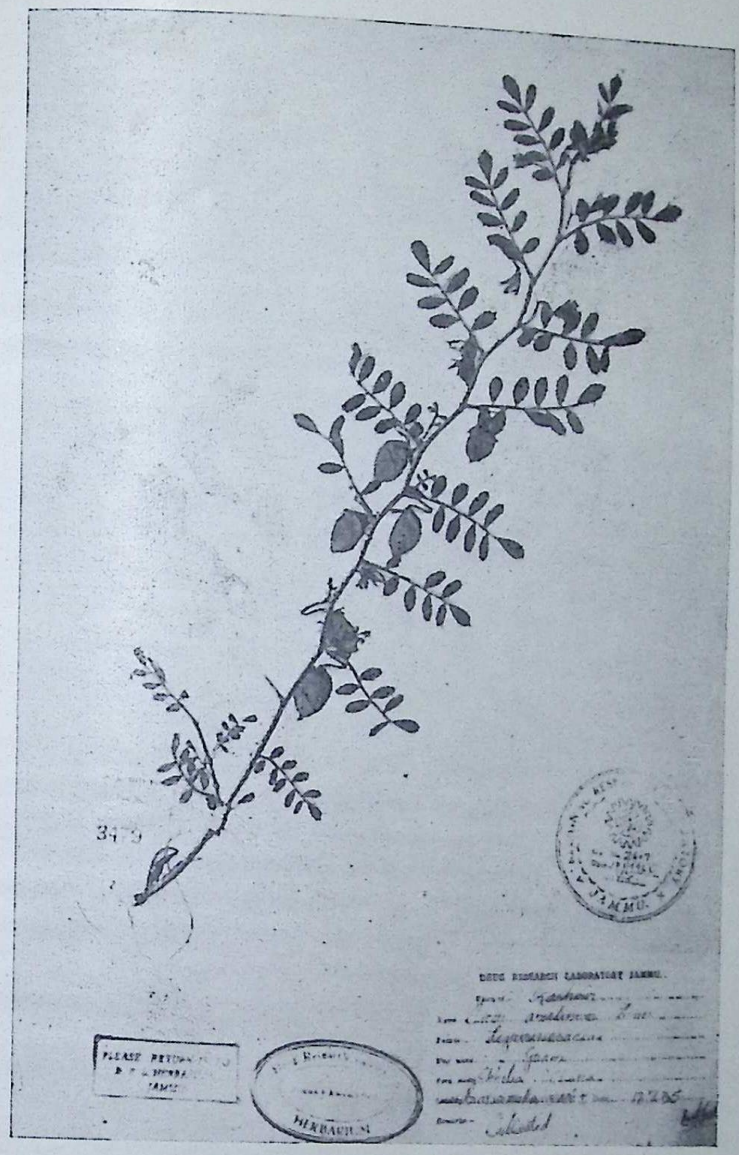

*Cicer arietinum*

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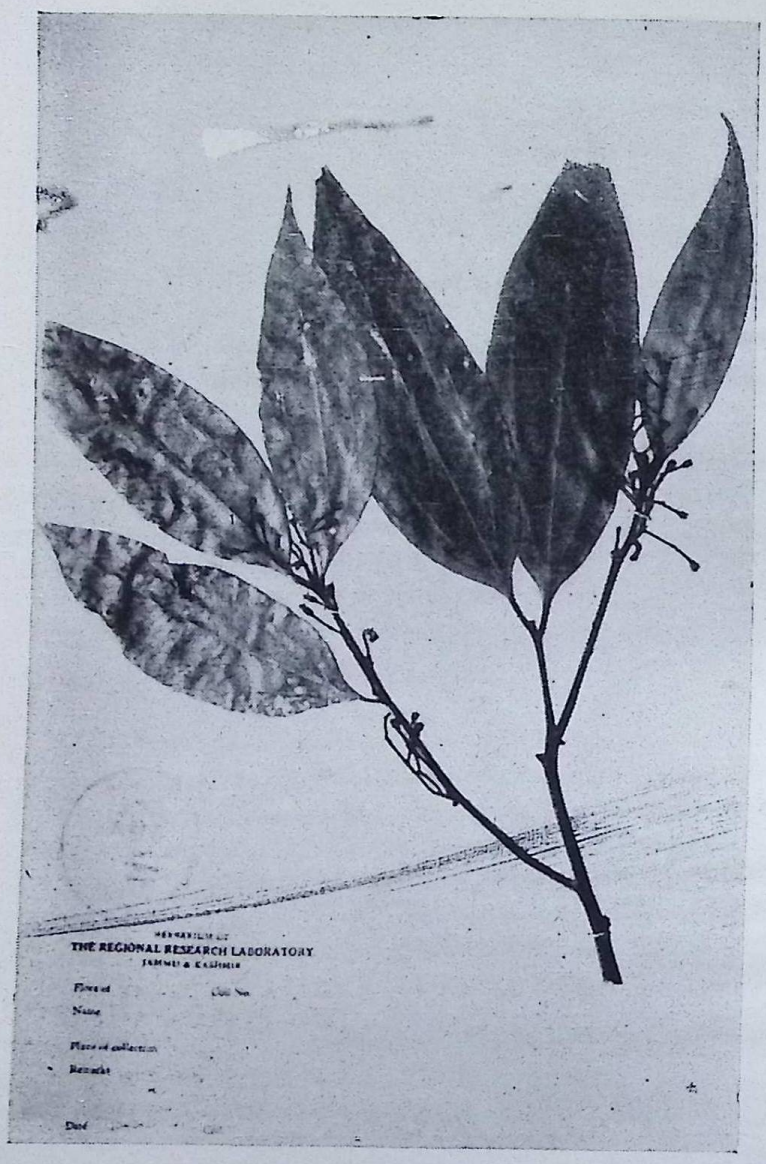


*Cinnamomum tamala*

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# CINCHONA (Rubiaceae)

*C. CALISAYA* Wedd.

Eng. — Cinchona bark, peruvian bark. Tam. — Kwainaamaram

**Habitat :** The most important species of Cinchona are now thoroughly acclimatised in India. Yellow cinchona bark (*C. calisaya*) grows best at the Himalayan plantations and Sikkim. The species of Cinchona grown in Bengal and Madras plantations are *C. ledgeriana*, *C. succirubra* and a hybrid of these two, *C. rubusta*. Pale brown cinchona bark is chiefly cultivated on the Nilgiris (near Ootaccamund) and in Ceylon and red Cinchona bark (*C. succirubra*, *C. rubrae*) grows well both in Bengal and also in plantations at Mungpoo in Sikkim and in south India (Chopra *et al.*, 1956; Nadkarni, 1954).

**Parts used :** Bark.

**Medicinal properties and uses :** The barks and all preparations of Cinchona are specially valuable in intermittent fevers. They have been prescribed as tonic in small doses of 1 to 3 grains in dyspepsia, gastric catarrh, adynamia and convalescence from fevers. The alkaloids quinine, quinidine, cinchonidine, cinchonine are valuable as antipyretics. As a tonic and antiperiodic, it has been used in the prophylaxis and treatment of malaria. Ten grain dose has been given in whooping cough, hay-fever, enlargement of spleen, hemicrania and other neuralgic affections. It has also been used in small pox, septic fevers, pneumonia, acute rheumatism, acute tonsillitis, acute nasal catarrh, pyaemia *etc.* Locally, as an antiseptic it has been used in abscesses, cavities and ulcers. Also it is used as a wash and gargle in sore-throat. The indiscriminate use of quinine in continuous and large doses for a long time weakens the heart, produces restlessness and cachexia (Nadkarni, 1954).

**Pharmacognosy :** Different species of Cinchona along with their hybrids were grown at Mungpoo in various plantations. The variation of the alkaloid content according to the age of the plant has been studied. Total alkaloids, quinine and cinchonidine were determined as they indicated the respective values of the bark. The young bark shows corky tissue which in the older ones is cast off. Sclerotic cells are more in the root bark than in the stem bark and their number also varies in young and older barks, being somewhat more in the older samples.

*C. ledgeriana* plants are richer, on an average, in alkaloid content; the hybrids come next whereas *C. succirubra* and *C. robusta* are poor in alkaloid content. From the 6th year onwards the quinine content of the plants increases. It has been suggested that proper genetical and physiological methods must be resorted to to improve the quality of Cinchona barks (Dutta and Bal, 1946).

**Chemistry :** It was found that methods involving elemental analysis and the preparation of nitroso derivatives were not of much use in characterisation of small quantities of Cinchona alkaloids, when mixtures were suspected or when pure crystalline derivatives

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were not easily obtainable. It was later found that the ultra-violet absorption of compounds offered a quick and reliable method for their characterisation (Popli and Dhar, 1960).

The glycosides isolated from the heartwood of *C. ledgeriana* on hydrolysis, gave an aglycone, $C_{30}$ $H_{46}O_5$ m.p. 307-8°, which was identified as quinovic acid. The sugars were identified as glucose, rhamnose and xylose, the last one being predominant. Quinine, cinchonine and another unidentified alkaloid were also isolated from the heart-wood in poor yields (Dutta and Quassim, 1968).

**Pharmacology :** The presence of quinoline ring has been found to be responsible for the negative inotropic activity of the alkaloids, cupreines and other related compounds isolated from *Cinchona* sps., on isolated heart's of frog and rabbit. Quinuclidine ring had almost no importance in determining this activity. Changes in the steric configuration and substitutions of alkoxyl at carbon-6 has also been found to be significant in increasing the activity (Arora *et al.*, 1956).

The *in vivo* and *in vitro* amoebicidal activities of emetine, conessine, quinine, quinidine and chloro-dihydro and hexa-hydro derivatives of desoxy quinine and quinidine have been determined in weanling albino rats. The activities of compounds obtained by modifying quinine and quinidine were not comparable to that of emetine. Chloro-9-desoxy quinine and quinidine were least active whereas 9-desoxy-dihydro derivatives showed fair activity. Majority of the compounds which showed slight *in vitro* activity were found active *in vivo*, the exceptions being 9-desoxydihydro quinine and quinidine which were found active *in vivo* (Kaushiva, 1958).

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## CINNAMOMUM (Lauraceae)

*C. INERS* Reinew

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Tejpat (leaves), dalchini (bark) | Mal. | — | Karuntoli |
| Eng. | — | Cinnamon | Mar. | — | Ranachadal |

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| | | | |
|---|---|---|---|
| Hind. | — Jangli dalchini | Sans. | — Tejapatra |
| Kan. | — Adavilavangapatre, dalchini | Tam. | — Ilavangam |

**Habitat :** Found in tropical and sub-tropical Himalayas, Uttar Pradesh, eastern Bengal, the Khasia and Jaintia hills and Burma.

**Parts used :** Leaves, bark and oil.

**Medicinal properties and uses :** It is a carminative, stimulant, diuretic, diaphoretic, deobstruent, and lactagogue. The oil distilled from the leaves is a powerful stimulant (Nadkarni, 1954).

*C. ZEYLANICUM* Breyn.

| | | | |
|---|---|---|---|
| Eng. | — Chinese cassia, cinnamon | Mal. | — Kulit-manis |
| Hind., Punj, Kash, Mar. Guj, Ben. and Kan. | — Dalchini | Tam. | — Lowangapattai |
| | | Tel. | — Dasamchakkalu |

**Habitat :** Indigenous to Ceylon, southern India and growing wild in western ghats from Konkan southwards and in the forests of Tennasserim (Burma).

**Parts used :** Dried inner bark of the shoots from truncated stalks and essential oil.

**Ayurvedic description**

| | | |
|---|---|---|
| Sanskrit : | *Twak* | |
| Synonyms : | *Surabhi, utkata, gudatwak, lataaparna, daarusheeta, tanutwak* | |
| Properties : | *Rasa* | — *Katu, tikta, madhura* |
| | *Guna* | — *Laghu, rooksha, teekshna, pichchila* |
| | *Veerya* | — *Ushna* |
| | *Vipaaka* | — *Katu* |
| Actions/Uses : | *Shukrala, varnya, kandooghna, aamadoshaghna, arucihara, hridrogaghna, vastirogaghna, arshorogaghna, krimighna, peenasaghna, kaasaghna, mukhashoshahara, trishaghna, agnimandyahara, aadhmaanaghna, vaantishamana, utkleshashamana, sangraahi.* | |

**Medicinal properties and uses :** Bark is carminative, antispasmodic, aromatic, stimulant, haemostatic, astringent, antiseptic, stomachic and germicide. The oil has no astringency but is a vascular and nervine stimulant; in large doses it is an irritant and narcotic poison (Nadkarni, 1954).

**Pharmacognosy* :** Pharmacognostic characters of the commercial samples of Cinnamon barks sold in the Indian market and the distinguishing features of the barks of *C. zeylanicum*, *C. pauciflorum*, *C. iners*, *C. tamala* and *C. obtusifolium* have been described (Datta and Datta, 1955). These have all been sold under the common name Cinnamon barks. The distinguishing features are given in the Table.

*No report available on other aspects.

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**The distinguishing features of the various species of cinnamon.**

| *Characters* | *C. zeylanicum* | *C. pauciflorum* | *C. iners* | *C. tamala* | *C. obtusifolium* |
|---|---|---|---|---|---|
| 1. Thickness | 1 mm. or less | 2-3 mm. | 2-4 mm. | 3-5 mm. | 5-8 mm. or more |
| 2. Taste | Strongly pungent, aromatic and sweet | Slightly sweet | Astringent and slightly pungent | Sweet and aromatic, less pungent | Slimy, very slightly bitter, sweet and very astringent |
| 3. Cork | Thin-walled, tangentially elongated | Same as in *C. zeylanicum* | Same as in *C. zeylanicum* | Same as in *C. zeylanicum* | Alternate layers thin and thick walled |
| 4. Phellogen | Not distinct | Distinct | Distinct | Distinct | Distinct |
| 5. Half stone cells | Absent | Present | Present | Present | Absent |
| 6. Stone cell layer | Continuous | More or less continuous or broken | Broken | Scattered | Widely scattered |
| 7. Pericyclic fibres | Present in groups, outside stone cell layer | Same as in *C. zeylanicum* | Distributed in the cortex | Distributed in the cortex | Distributed in the cortex |

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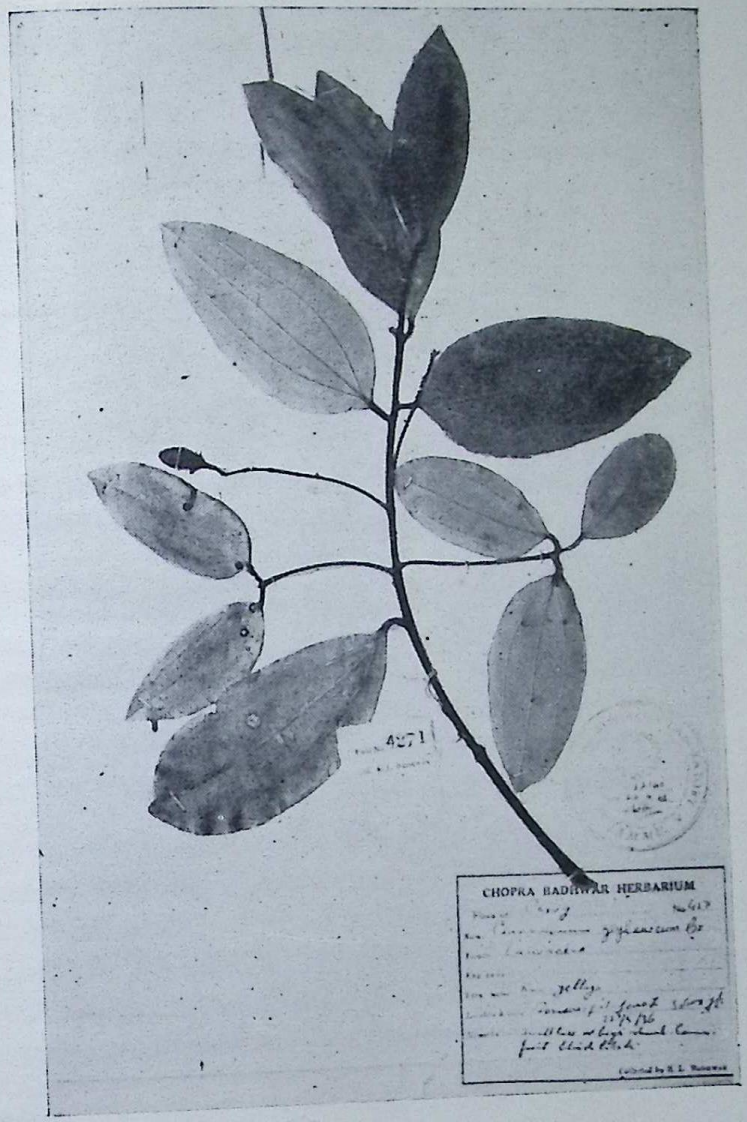


*Cinnamomum zeylanicum*

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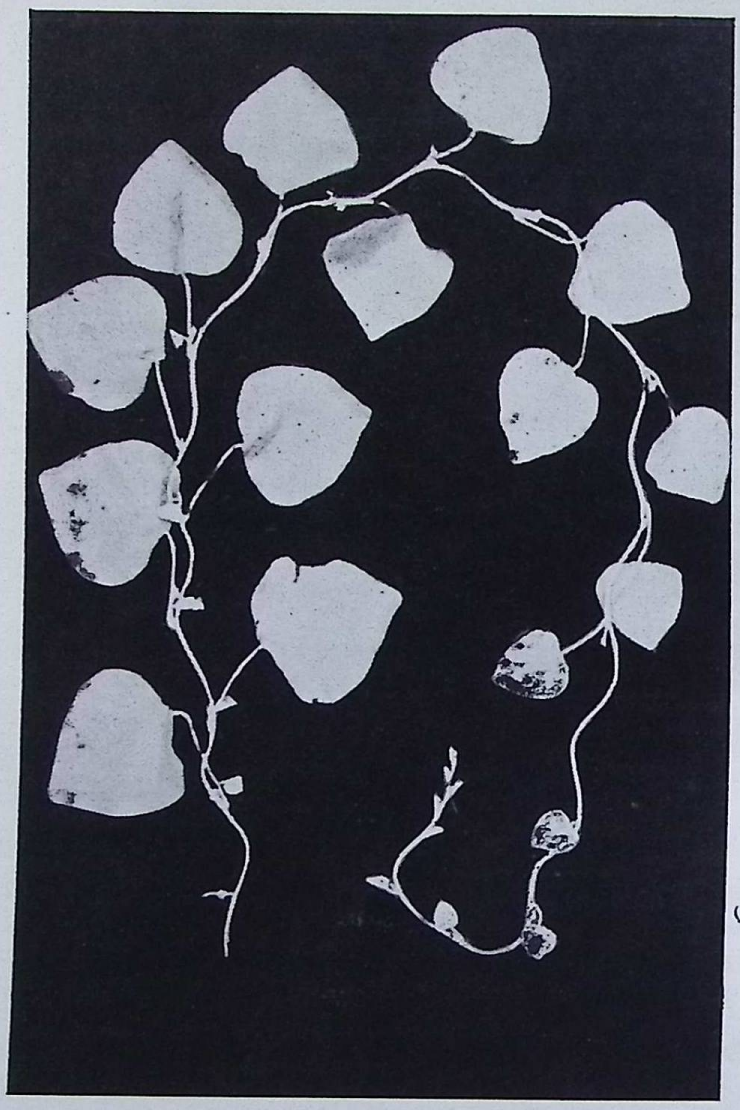

*Cissampelos pariera*

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It has been reported that crude drug from three different sources is being sold under the name *Nagkesar* in Gujarat. The drug prevalent in the northern districts of Saurashtra and in Bhuj as *Nagakesara* has been identified as the immature fruits of a species of *Cinnamomum*. Macroscopically the fruits are enclosed in the perianth. The perianth lobes are incurved at the top and the whole fruit presents a truncated appearance. Perianth has been found to be pubescent on both inner and outer surfaces. The detached fruit is shiny, smooth-walled, globose, minutely apiculate due to a scar left by the style. Anatomically the pedicel shows heavily cutinised epidermis with thick walled cells. Parenchymatous cortex having scattered sclerified cells with pits followed by pericycle is also present.

Out of twelve samples from the market only one comprised stamens of *Mesua ferrea* Linn, which is popularly accepted as genuine *Nagakeshara* (Satkopan and Thomas, 1968).

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## CISSAMPELOS (Menispermaceae)

*C. PAREIRA* Linn.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Akanadi | Mar. | — | Paharval |
| Eng. | — | Velvet-leaf | Punj. | — | Katori |
| Guj. | — | Karandhis | Tam. | — | Appattakodi, vattatiruppi |
| Hind. | — | Harjori | Tel. | — | Pata |

**Habitat :** Grows in tropical and subtropical parts of India from Sind and Punjab to south India and Ceylon.

**Parts used :** Root bark and leaves.

**Ayurvedic description**

Sanskrit *Paatha*

Synonyms : *Ambhashta, varatikta, peeluphala, paapachelee, susthira, praacheena, kuchala*

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Properties : *Rasa* — *Katu, tikta*
*Guna* — *Guru, laghu, teekshna*
*Veerya* — *Ushna*
*Vipaaka* — *Madhura, katu*

Actions/Uses : *Vranaropana, vishaghna, garavishaghna, kushtaghna, kandooghna, deepani, vrishya, ateesaarashamani, shoolaghni, chardishamani, hridrogahara, jwaraghna, bhagnasandhaanakara, daahashamani, shwaasahara, krimighna, gulmahara, grahaneerogashamani, arshoghna.*

**Medicinal properties and uses :** It is a mild stomachic, bitter tonic, diuretic and antilithic. It has been considered to exercise an astringent and sedative action on the mucous membrane of the genito-urinary organs (Nadkarni, 1954).

**Chemistry :** The roots of the plant have been found to be very rich in alkaloids. In addition some other constituents have also been isolated in crystalline form. The constituents reported are : (*i*) an alkaloid provisionally named hayatin, m.p. 303° obtained as rectangular plates from aqueous pyridine, (*ii*) a subsidiary alkaloid, provisionally named hayatinin, m.p. 263°, obtained as hexagonal plates from chloroform or acetone (*iii*) quercitol, m.p. 235° and (*iv*) a sterol, m.p. 140-41° (Bhattacharji *et al.*, 1952).

The roots of *C. pareira* from Kashmir gave two alkaloids, hayatin and hayatinin and d-quercitol. The Pilibhit root sample yielded hayatin and l-bebeerine and no hayatinin or d-quercitol. Both the samples gave an essential oil and a sterol. On the basis of the complete similarity of the ultraviolet absorption spectra of hayatin and bebeerine, a bisbenzyl isoquinoline structure was suggested for hayatin (Bhattacharji *et al.*, 1955, 1956).

Optical inactivity of hayatin indicated a symmetrical structure for the molecule. The structure of hayatin has been elucidated. Symmetrical bis-benzyl isoquinoline has been synthesised (Agarwal *et al.*, 1960).

The structure of hayatinin, $C_{37}H_{40}N_2O_6$, a subsidiary base isolated from the roots showed that it had one hydroxyl, three methoxyl and two methylimino groups. Hoffman degradation of 0'-methyl hayatinin dimethiodide to 0, 0'-dimethyl bebeerilene and trimethylamine showed that hayatinin had the skeletal structure of a bisbenzyl tetrahydroisoquinoline and that the six oxygen atoms were oriented as in bebeerine. The location of the free hydroxyl group at the 7 position of the isoquinoline ring was suggested by the Millon and diazonium coupling reaction and has been confirmed by Hoffman degradation of 0-ethyl hayatinin dimethiodide to the corresponding bebeerilene and oxidation of the latter to two tricarboxydiphenyl ethers, one of which contained the ethyl group in the appropriate position (Bhattacharji *et al.*, 1962).

Identification and characterisation of bisbenzylisoquinoline alkaloids have been attempted by TLC employing several solvent systems. None of the solvent systems could effect a complete resolution of all the alkaloids but the alkaloids could be satis-

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factorily resolved employing a combination of two or more of these solvent systems (Bhatnagar and Bhattacharji, 1965).

The presence of curine and hayatin was confirmed in *C. pareira*, and d-iso-chondrodendrine was also obtained from it. Three water soluble quaternary bases and a bis-base containing a dihydroisoquinoline nucleus were also isolated from the same plant. Of these alkaloids, curine, isochondrodendrine and cycleamine have been shown to have the L-(—)-configuration (Kupchan *et al.*, 1960).

Sodium and liquid ammonia reduction of hayatinin ethyl ether afforded a non-phenolic component, which was identified as dl-4′-0-methyl-7-0-ethyl-N-methylcoclaurine, and a phenolic component identified as dl-N-methylcoclaurine. The structures of these two fragments have been confirmed by NMR and mass spectral data as well as by the synthesis of the former by routine methods. This established the structure of hayatinin as 4′′-0-methyl-bebeerine. The optical inactivity of hayatinin as well as of phenolic and nonphenolic fragments suggested that hayatinin isolated from this plant was a racemic mixture (Bhatnagar and Popli, 1967*a*).

With a view to establish the structure of hayatin as well as to determine the stereochemistry at the two asymmetric centres in the molecule, sodium and liquid ammonia reduction of hayatin diethyl ether was undertaken. Hayatin diethyl ether on reduction gave a non-phenolic compound, m.p. 64°, $C_{22}H_{29}NO_3$ and a phenolic compound which could not be crystallised. However, the Rf value of the phenolic compound on TLC was identical with that of N-methylcoclaurine. The non-phenolic fragment was identified on the basis of mass spectrum and the NMR as 4′-0,0-diethyl-N-methylcoclaurine. The confirmation of the structure of the phenolic and non-phenolic fragments and the fact that both hayatin and its sodium and liquid ammonia reduction products were optically inactive, clearly established the structure of dl-bebeerine. The structure has been fully supported by the NMR and mass spectra of hayatin and its diethyl ether. It was also pointed out that the biological activity reported for hayatin dimethiodide agreed very closely with the computed values for dl-bebeerine dimethiodide on the basis of reported activities of the corresponding quarterary compounds of d and l-bebeerine (Bhatnagar *et al.*, 1967).

Hayatidin, m.p. 179-180°, molecular formula $C_{37}H_{40}N_2O_6$ was also isolated. Its structure was established and it was found to be a stereoisomer of (++)-4′′-0-methyl-curine. To study the stereochemistry at two centres in the alkaloid, hayatidin methyl ether was subjected to sodium and liquid ammonia reduction. The phenolic fragment was laevo-rotatory and could not be obtained in crystalline form. It had the same Rf on TLC as N-methylcoclaurine. Thus, the structure of phenolic fragment was confirmed as 1-N-methylcoclaurine. The non-phenolic fragment also could not be crystallised and was dextro-rotatory. The evidence showed that its structure could be d-1-p-methoxybenzyl-6-methoxy-7-ethoxy-2-methyl-tetrahydroisoquinoline. Therefore, the structure of hayatidin was established as (+—)-4′′-0-methyl bebeerine (Bhatnagar and Popli, 1967*b*).

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The total content of alkaloids and their composition in the plant varied according to the region from which the roots were collected. The roots from Kashmir gave 1·8 per cent of total bases which did not contain any l-bebeerine, while the roots from U.P. had an alkaloid content of 1·2 per cent of which l-bebeerine constituted one third. The yield of hayatin also varied ranging from 0·25 per cent in Kashmir, 0·1 per cent in U.P. while only 0·005 per cent was found in Madras roots, which again contained l-bebeerine as the major constituent. The following alkaloids have been separated and crystallised from *C. pareira.*

(1) Cycleanine, $C_{38}H_{42}N_2O_6$, (0, 0-dimethyl isochondrodendrine) m.p. 272-273°, methiodide, m.p. 300-301° (dec.).

(2) Hayatidin, $C_{39}H_{44}N_2O_7$, m.p. 179-180°, methiodide m.p. 258-259° (dec.), UV absorption spectrum similar to that of bebeerine.

(3) Hayatinin, the benzene soluble portion consisted almost entirely of hayatinin $C_{37}H_{40}N_2O_6$, m.p. 231-232°, UV-spectrum similar to that of bebeerine.

(4) Hayatin, the more soluble hydrochloride fraction was recrystallised from water and then methanol to give needles, m.p. 265-268° (dec.).

(5) Orange base, the less soluble hydrochloride fraction, was recrystallised from water and then propanol which gave yellow needles shrinking at about 95° and melting at 237°.

A number of water-souble bases were isolated from the ammoniacal filtrate, after precipitation of the tertiary bases. Three of these bases have been crystallised and characterised as (*i*) menismin iodide (*ii*) cissamin chloride (*iii*) pareirin chloride (Bhattacharji and Dhar, 1967).

One of the alkaloids isolated from the roots was identified as cycleanine. Some discrepancies in its NMR spectrum were pointed out (Bhatnagar *et al.*, 1968).

Cissamine chloride isolated from the roots of *C. pareira*, known as a protoberberine alkaloid was identified as cyclanoline chloride from *Stephania tetrandra* (Falak *et al.*, 1968).

Cycleanine, l-bebeerine, hayatidin, hayatinin, hayatin and d-quercitol have also been isolated from the leaves. Different fractions like fraction A on preparative TLC gave l-bebeerine, fraction B afforded cycleanine, fraction C gave hayatin and hayatinin whilst fraction D gave hayatin (Chowdhury, 1972).

**Pharmacological and clinical studies :** Hayatin and its various derivatives were found to possess neuromuscular blocking action. Their effect on CNS was studied in cats and dogs by intraventricular, intracisternal and intrathecal injections. Hayatin methiodide in a dose of 0·4 mg. in cats and 0·5 mg. in dogs increased somatic reflexes and generalised convulsions. Besides, rise in blood pressure and stimulation of respiration was also observed. The potency of methochloride derivative was more or less similar to that of methiodide. Dimethyl hayatin methiodide was more potent whereas hayatin

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hydrochloride was very weak. The site of their action was considered to be mainly supraspinal and very slightly on spinal cord (Sur and Pradhan, 1963).

Low doses of hayatin methiodide had little action on the blood pressure but higher doses caused a fall in intact and spinal dogs, rabbits and cats. The fall could be prevented by pretreatment with anti-histaminics. The drug had little action on heart, isolated or *in situ*. It caused temporary increase in limb volume and a decrease in the spleen volume. In lower doses, the drug depressed the respiration while higher doses caused paralysis. It had no curariform action on oral administration. After intravenous injection, it caused increased gastric and bile secretion and gastric acidity. Its curariform action could be prevented or reversed by salts of physostigmine. In pigeon, it caused muscular paralysis resembling that caused by curare (Pradhan *et al.*, 1958).

The toxic effects of hayatin methiodide were studied in rats and dogs. The drug was found to be non-toxic (Lahiri and Pradhan, 1964). Hayatin methiodide and methochloride were found to possess almost an equal degree of curariform activity as compared to d-tubocurarine chloride, but the fall of blood pressure, respiratory depression and autonomic blocking effect appeared to be less marked. Hayatin hydrochloride was found to have no such effect (Pradhan *et al.*, 1962; Mukerji and Bhandari, 1959).

Hayatinin methochloride possessed similar muscle relaxant properties as d-tubocurarine chloride in cat, dog, mice and rabbit. During steady partial block by the compound, the response to brief tetanic stimulation to neostigmine and to an increase in Ca-concentration was similar to those observed during block by d-tubocurarine. It was frequency-dependent in its blocking activity. Hayatinin caused postsynaptic block (Basu, 1970).

The estimation of hayatin methiodide in blood and urine of dogs and human patients was studied by spectrophotometric method. In the plasma of dogs and human patients, 1·0-2·8 mg./kg. body weight of the drug was given intravenously and the peak concentration in blood was found within 2 minutes of administration after which it gradually decreased and could not be detected after 15 minutes. When a dose of 2·0 to 2·8 mg./kg. body weight was given intravenously in dogs, the total amount of the drug excreted in urine in 3 hours was 4-8 per cent of the total dose injected and the amount excreted later on was very slight or nil (Basu and Pradhan, 1964).

Hayatin methiodide was tried as a muscle relaxant during surgery in 100 patients. The drug provided adequate relaxation for endotracheal intubation and surgery. It appeared to be about one-third as potent as tubocurarine. The duration of relaxation by both these drugs was equal in equipotent doses. The neuromuscular block produced by this drug could be completely reversed by neostigmine. It was relatively free from serious side effects and appeared to be a promising muscle relaxant. It produced a transient fall in blood pressure of varying intensity. In three patients a generalised urticarial rash was observed after administration of the drug, which

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dis appeared spontaneously in about half an hour. A transient rash was observed in a nother patient along the course of the vein through which the drug was injected (Pradhan *et al.*, 1964).

A comparative study of the activities of hayatin hydrochloride and its seven derivatives revealed that the methyl group whether attached to an N or O atom of the hayatin molecule increasd curariform activity whereas ethyl and butyl groups gradually decreased it. The curariform potency of methiodide and methochloride derivatives was almost equal to that of d-tubocurarine chloride; the methyl ether methiodide was 2·5 times more potent than d-tubocurarine and was the most potent in the series. The effects on blood pressure and respiration followed the same pattern as the curariform activity. The ganglion blocking action appeared to be associated with ethyl and butyl groups but not with methyl group (Pradhan and De, 1959).

Hayatin methyl ether methiodide has been found to be more than twice as potent as d-tubocurarine chloride and hayatin methiodide. The neuromuscular blockade produced was of the competitive type and doses producing complete skeletal muscular paralysis depressed the respiration by about 50 per cent (Ray *et al.*, 1960).

The cardiac effects of hayatin methochloride and other histamine releasers like (+)-tubocurarine, compound 48/80, polymixin B sulphate and histamine, have been studied on isolated hearts and atria of guineapigs, rabbits and cats and on the eudynamic papillary muscle of cats. The isolated hearts and atria of guineapigs were much more sensitive to the cardio-stimulant action of hayatin methochloride. The results suggested that hayatin methochloride had a direct action on the cardiac tissue of all the three species. Histamine, under these experimental conditions, failed to exert any cardiostimulant action on the eudynamic papillary muscle of cat (Patnaik and Vohra, 1967).

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# CISSUS (Vitaceae)

*C. QUADRANGULARIS* Wall. (Syn. *Vitis quadrangularis* Wall., *Heliotropium indicum*). Linn.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Hasjora | Mal. | — | Isgangalam |
| Guj. | — | Hadsankal | Tam. | — | Pirandai |
| Hind. and | | | Tel. | — | Nullerutigeh |
| Mar. | — | Harsankar | Urdu | — | Hadsankal |
| Kan. | — | Sanduballi, Mungaravalli | | | |

**Habitat :** Found in hotter parts of India.

**Parts used :** Root, stem and leaves

**Ayurvedic description**

Sanskrit : *Asthisanhaara*

Synonyms : *Asthishrinkhala, granthimaan, vajraangee, vajravallee, chaturdhaara, Kaandavallee*

Properties :
*Rasa* — *Madhura*
*Guna* — *Rooksha, laghu, sara*
*Veerya* — *Ushna*
*Vipaaka* — *Katu* (*amla* ?)

Actions/Uses : *Stambhana, deepani, paachani, anulomani, krimighna, raktashodhani, raktastambhani, vrishya, netrarogahara* (*timirahara*), *arshoghna, balaprada, bhootopadravahara, vaataraktaghna, apasmaaraghna, vaatarogashamani, bhaghnasandhaanakara.*

**Medicinal properties and uses :** Powdered root is used for the fractures of the bones, with the same effects as plaster. The total ash obtained from leaves and young shoots are administered in dyspepsia, indigestion and bowel complaints. They are also considered as powerful alteratives. Juice of stem is dropped into the ear in otorrhoea and into the nose in epistaxis. Stem beaten into a paste is given is asthma. A preserve of stem prepared by boiling it in lime-water is a useful stomachic (Nadkarni, 1954).

**Pharmacognosy :** The diagnostic characters of the stem have been described.

Macroscopic characters : Fresh stem is thick, fleshy, succulent, quadrangular with acutely 4-angled or 4 winged internodes and contracted nodes. Fracture is short and fibrous, and fractured surface is greenish yellow in colour. Odour is distinct, with an acrid taste.

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Microscopic characters : A transection of internode shows a 4-angled outline. Epidermis consists of single row of cells covered with a thick cuticle and tabular cells. Numerous stomata are found on the epidermis. Cortex is composed of several layers of thin walled parenchyma cells. At places outer cells show formation of radial walls, some cells contain chloroplasts or starch grains or raphides of calcium oxalate. Embedded in the cortex are some secretory cells. At the corners internal to epidermis, 3 to 4 layers of compactly arranged sclerenchymatous cells are seen. Next to the sclerenchymatous zone are found 3 to 4 layers of rectangular cork cells, arranged compactly without any intercellular spaces. The phellogen arises in the sub-epidermal layer. With the angles in cortex, collenchyma occurs in the form of discrete strands. Individual collenchyma cells are isodiametric, with cellulosic thickenings at their angles. The endodermis is not distinguishable. Vascular bundles are collateral, open and arranged in a ring around the large central pith. Pith constitutes more than half of the thickness of stem and is composed of large parenchyma cells compared to the cortical parenchyma cells.

The microscopic studies of the powder (pale yellow to pale brown coloured) showed numerous starch grains which are simple, elliptical, oval or round, raphides, fragments of lignified fibres, stomata *etc.* (Madan and Nayar, 1959).

**Chemistry :** The plant was found to have a steroidal principle m.p. 134-136°. The UV and IR studies indicated the presence of 4 : 5, 6 : 7 unsaturation with at least three chromophore groups C=0, C=C and C≡C together with exocyclic double bond and conjugated chain (Sen, 1964).

The crude steroidal principle gave two distinctly separate constituents with very close Rf values. On rechromatography, two principles I and II were obtained from petroleum ether and ether solvent respectively. The microchemical analysis indicated molecular formula $C_{27}H_{45}O$ for principle I and molecular formula $C_{23}H_{41}O$ for principle II (Sen, 1966).

**Pharmacology :** A water soluble crystalline glucoside obtained from the stem of the plant did not produce any toxic effect on oral administration (1 mg./kg. daily for 10 days) to mice, rats and guineapigs for six weeks. However, on intravenous administration, the animals developed convulsions and died in five minutes. The MLD worked out to be 15·5 mg./kg. in guineapigs. The glucosides produced hypotension in anaesthetized dogs which was dose dependent. Fall in blood pressure was also observed in vagotomised, atropinised and spinal animals. The drug was found to be surface acting since the effect could be washed even after exposing the atrial tissue for three hours. The negative chronotropic effect produced by the glucoside was specific since the atrial tissue responded to small doses of isoprenaline and histamine during the negative chronotropic phase. The negative chronotropic effect produced by the drug could be surmounted with 7·5 M of calcium. The drug produced a fall in blood pressure by its negative

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chronotropic effect on the myocardium. It acted on the cell membrane by inhibiting the permeability of calcium ions into the cell substance (Subbu, 1968, 1970, 1971).

The water soluble fraction of 80 per cent alcoholic percolate of the plant was found to have acetylcholine-like action on the isolated ileum of rabbit and albino rat, rat uterus, dog's tracheal muscle and ileum *in situ* of dog. The effects of the drug on dog's blood pressure were analogous to the muscarinic and nicotinic actions of acetylcholine. The action of the drug on the perfused frog heart, however, was different from those of acetylcholine in the following respects : (*i*) atropine could not completely block the cardio-depressant action of higher doses of the drug, (*ii*) it showed cardiotonic activity in atropinized heart, (*iii*) it had independent respiratory action (stimulation followed by depression) and (*iv*) the drug was inactive on skeletal muscle (Das and Sanyal, 1964).

The effect of the total extract of the plant on the healing of cortisone-treated fractures has been compared with that of the anabolic hormone Durabolin. Total extract of the plant, on parenteral administration, was found to neutralize the anti-anabolic effect of cortisone in healing of fractures. The stimulatory effect of the total extract was found greater than that of the anabolic hormone probably due to its vitamin contents (Prasad and Udupa, 1963).

The total extract was found to hasten fracture healing by reducing the total convalescence period by 33 per cent in experimental rats and dogs (Udupa and Prasad, 1964*a*). The drug had a definite influence both on the organic and mineral phase of fracture healing leading to quicker recovery of the animals. The $Ca^{45}$ up-take studies indicated early completion of calcification process and earlier remodelling phenomenon. The tensile strength studies showed an early gain, leading to a 90 per cent gain of its normal strength at the end of six weeks in comparison to 60 per cent gain in strength noted in the controls (Udupa and Prasad, 1964*b*).

The plant extract has been found to influence fracture healing indirectly only and not directly. Its effect on organic and inorganic phases of bone repair in normal and some pathological conditions like alloxan diabetes and in cortisone-treated animals, and its effect on endocrine response during fracture healing suggested that the parenteral administration of the drug acted directly on the testis and through the pituitary to release the androgenic hormone into blood. The other evidence of its androgenic property was its positive nitrogen balance, increase in body weight and total weight of testis of animals (Prasad and Udupa, 1969). A potent anabolic steroid isolated from the plant showed a marked influence on the rate of fracture healing by influencing early regeneration process of all connective tissue cells involved in the healing and quicker mineralization of the callus (Udupa *et al.*, 1965). The phytogenic steroid increased the total weight of the testis at the end of 48 hours after fracture (Prasad *et al.*, 1970).

The pathway and site of action of the phytogenic steroid was studied by tagging it with radioactive $C^{14}$. Its site of action could be located in the rats with the

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help of micro-autoradiography of various tissues and organs. The probable pathway seemed to be through anterior pituitary followed by adrenals and testes. After some metabolism in the liver, the steroid reached the osteogenic cells at the fracture site where it seemed to exert a stimulating effect on healing of the fracture (Prasad and Udupa, 1972).

The alcoholic extract of the aerial parts of *C. setosa* was found to have antiprotozoal activity against *Entamoeba histolytica* (Dhar *et al.*, 1968).

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# CITRULLUS (Cucurbitaceae)

*C. COLOCYNTHIS* Schrad.

| | | | | | |
|---|---|---|---|---|---|
| Ben., Hind. and Guj. | — | Indrayan, makhal | Kon. | — | Kavandali |
| Eng. | — | Colocynth, Indian wild gourd | Mar. | — | Kadu-indravani |
| | | | Punj. | — | Ghurumba |
| | | | Tam. | — | Paeikummatti |
| Kan. | — | Haavumekkae | Tel. | — | Eti-puchcha. |

**Habitat :** Common weed found wild in the sandy lands of north-west, central and southern India, and on the Coromandal coast. Colocynth is not systematically grown anywhere in India.

**Parts used :** Fruit deprived of its rind, root, dried pulp of the fruit freed from seeds.

**Ayurvedic description**

Sanskrit : *Indravaarunee.*

Synonyms : *Aindree, gavaakshee, chitraphala, surendraahwa, sukhaarunee, kshudra-phala, vrishabhaakshee, mrugabhaksha, aatmaraksha, sthaanukarnee, chitradevee, mahaaphala, dhanuhshrenee, trapusee, gajachirbhatee, gavaadanee, hastidantee, sooryaahwa, marusambhava.*

Properties :

| | | |
|---|---|---|
| *Rasa* | — | *Tikta, katu* |
| *Guna* | — | *Laghu, rooksha, teekshna.* |
| *Veerya* | — | *Ushna* |
| *Vipaaka* | — | *Katu* |

Actions/Uses : *Virechanee, vranahara, krimighna, shwaasahara, kaasahara, apacheeghna, kushtaghna, pleehodarahara, garavishaghna, kaamalaahara, moodhagarbhahara, pramehaghna, granthighna, gandamaalaahara, vishaghna, sleepadaghna, gulmahara, jwarahara.*

**Medicinal properties and uses :** Colocynth in moderate doses is a drastic hydrogogue cathartic and diuretic; in large doses it is emetic, and gastro-intestinal irritant and in small doses it is expectorant and alterative. Colocynthin is intensely bitter and has a purgative action. All parts of the plant are very bitter. The fruit has been described as cathartic (Nadkarni, 1954).

**Pharmacology*** : Coloside A, a glycoside isolated from the pulp of the plant showed anti-histaminic and antiacetylcholine-like activity on isolated rabbit intestine and guineapig

*No report available on other aspects.

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ileum. It exhibited negative chronotropic and inotropic activity in isolated rabbit's heart. It diminished the force of contraction of the ventricle and reduced the heart rate in frog heart perfusion and straub heart preparation. It had no effect on dog's heart *in situ* and dog blood pressure. It failed to stimulate the isolated rat uterus but revealed purgative properties (Banerjee and Dandiya, 1967).

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## CITRUS (Rutaceae)

*C. AURANTIUM* Linn. (Syn. *C. vulgaris* Risso).

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Kamla-neboo | Kon. | — | Sonnaringa |
| Eng. | — | Sweet or Chinese orange, orange | Mal. | — | Madhurana rakam |
| | | | Punj. | — | Santara |
| Guj. and Mar. | — | Suntra, narangi | Tam. | — | Narangam, kamlaiapazam |
| Hind. | — | Narang, santra | | | |
| Kan. | — | Kittalay | Tel. | — | Gajanimma |

**Habitat :** Grown all over India chiefly in the warmer and moist regions, Khasia hills in Assam, and central provinces.

**Parts used :** Rind (fresh and dried outer parts of the pericarp), flowers and the volatile oil distilled from fresh flowers.

**Ayurvedic description**

Sanskrit : *Naaranga*

Synonyms : *Naagaranga, naarangaka, twaksugandha, mukhapriya, yogasaara, yaugika, paaraavata, sudha*

Properties : *Rasa* — *Madhura, amla*
*Guna* — *Guru, snigdha, sara, vishada*
*Veerya* — *Sheeta,* (*ushna* ?)
*Vipaaka* — *Madhura*

Actions/Uses : *Ruchya, deepanee, paachanee, trishnaahara, chardighna, hridya, rakta-pittahara, aamadoshahara, krimihara, udarashoolahara, shramaghna, balya*

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**Medicinal properties and uses :** Dried rind is aromatic, stomachic, tonic, astringent, mild carminative and anti-scorbutic. Oil distilled from the flowers is not only a perfume but also antispasmodic and anodyne. Orange water is stimulating and refreshing. Juice is refrigerant and stomachic. Orange is rich in vitamins, and is considered to help in digestion (Nadkarni, 1954).

**Chemistry* :** The peels of *C. aurantium* when air dried and extracted with ligroin, yielded a rare flavonoid named auranetin. Subsequent alcoholic extract gave the glycoside hesperidin, which was also obtained by direct extraction of the rags left after expression of juice (Patnayak *et al.*, 1942). Auranetin was found to be a fully methylated flavonol. By analytical studies, its constitution was established as 3, 6, 7, 8, 4′ penta-methoxy flavone and this was also confirmed by synthesis (Murti *et al.*, 1948). A later examination of the peels of the same variety yielded another new flavonoid whose constitution was established as 5-hydroxyauranetin. The Nagpur variety was found to contain in its peels besides auranetin and hesperidin, a third compound whose structure was determined as 5-0-desmethyl nobiletin (Sarin and Seshadri, 1960).

The tincture and infusion of *C. aurantium*, have been included in Indian Pharmacopoeia, for their carminative action. However, no chemical standards were given for the drug in the literature before the pectins and glucosides were determined. Four samples were collected from reliable drug dealers and duly identified by botanical examination. The pectins and glycosides were estimated by simple methods which gave consistent results when repeated three times. Variation was noted in the total glycosidal (0·38-0·71 per cent) and pectin content as calcium salt (16·68-20 per cent). This variation may be due to different localities from which the samples were procured (Sarin *et al.*, 1960).

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*No report available on other aspects.

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# CLAUSENA (Rutaceae)

*C. HEPTAPHYLLA* Wt. and Arn.

**Habitat :** Grows in western ghats of India.

**Parts used :** Roots.

*C. INDICA* Oliv.

**Parts used :** Root.

**Chemistry* :** From the roots of *C. heptaphylla*, two pyranocoumarins were isolated, *viz.* clausenin $C_{14}H_{12}O_5$, m.p. 156-157°, and clausenidin $C_{19}H_{20}O_5$, m.p. 135-136°. On the basis of spectral and degradative evidences, their structures have been established. Clausenin and clausenidin were the only examples of naturally occurring coumarins fused to a dimethylpyranone ring. Clausenidin was the first example of a natural coumarin bearing an α-α—dimethylallyl group (Joshi *et al.*, 1967*a*).

The constitution of clausenin was confirmed by its synthesis by Joshi *et al.* (1967*a*) and of its methyl ether by a simplified process by Bhargava and Seshadri (1971). The constitution of clausinidin originally proposed by Joshi *et al.* (1967*a*) was revised by Fuhrer *et al.* (1970) and confirmed by the synthesis of the methyl ether by Bhargava and Seshadri (1971).

Clausenin on methylation, reduction and dehydration of the secondary alcohol gave xanthoxyletin. The angular isomer of clausenin by a similar series of reactions gave alloxanthoxyletin (Ganguly *et al.*, 1967).

The isolation and structure of a new alkaloid heptaphylline has also been reported. The oil obtained by hot extraction of the roots with hexane after chromatographic separation on silica gel gave in low yield, a yellow crystalline weakly basic alkaloid, with molecular formula $C_{18}H_{17}NO_2$. On the basis of NMR and UV spectra the structure for heptaphylline and cycloheptaphylline have been elucidated (Joshi *et al.*, 1967*b*). Synthesis of heptaphylline has also been described (Joshi and Rane, 1968). Its structure has been further confirmed (Joshi *et al.*, 1972).

Imperatorin and two new coumarins, dentatin and nordentatin were isolated from the root bark of *C. dentata*. Dentatin was shown to be a new pyranocoumarin (Govindachari *et al.*, 1968).

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*No report available on other aspects.

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From the roots of *C. indica*, the furanocoumarins, imperatorin, phellopterin, xylotenin and the dihydrofuranocoumarin, chalepin have been isolated. Their structures have been established (Joshi and Gawad, 1971).

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# CLEISTANTHUS (Euphorbiaceae)

*C. COLLINUS* (Roxb.) Benth. and Hook.

| | | | |
|---|---|---|---|
| Ben. | — Karlajuri | Tam. | — Nilappaalai |
| Hind. | — Garari | Tel. | — Kadishe |

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**Habitat :** Grows in Bihar, Madhya Pradesh, Orissa, northern Circars, Karnataka and Deccan specially Hyderabad and Malabar.

**Parts used :** Bark, root, leaf and fruits.

**Medicinal properties and uses :** Plant is extremely poisonous and astringent. Extract of the leaves, roots and fruits is used in violent gastro-intestinal disorders. Root, leaf and bark are used as fish poison (Chopra *et al.*, 1956).

**Chemistry :** The chemical examination of the petroleum ether extract of the fruits showed the presence of sterol and triterpenoids, apart from tannins, in the alcohol extract. The non-saponifiable fraction when chromatographed over neutral alumina gave two compounds with m.p. 183-87° and 123-127°. These appeared to be lupeol and β-sitosterol acetate respectively (Maiti and Das, 1965).

The acetone extract of the leaves furnished ellagic acid, m.p. 360°, and a new lactone named collinusin m.p. 196°, molecular formula $C_{21}$ $H_{18}O_6$. Its UV spectrum was similar to that of γ-apopicropodophyllin. Zeisel determination showed the presence of two methoxyl groups and a positive chromatropic acid test supported the presence of a methylene dioxy group. The structure of collinusin has been elucidated.

Dehydrogenation of collinusin with palladised charcoal yielded optically inactive dehydrocollinusin, m.p. 235-236°, molecular formula, $C_{21}H_{16}O_6$. Its NMR spectrum showed the presence of two methoxyl groups, a methylenedioxy group and six aromatic protons. Its structure has also been determined. The physical properties of dehydrocollinusin resemble those of justicidin B (Govindachari *et al.* 1967*a*).

Diphyllin has been isolated along with other compounds from the leaves. It was first isolated from *Diphylleia grayi* roots and hence the name. The structure for diphyllin as well as justicidin has been re-examined and revised. Diphyllin, $C_{21}H_{16}O_7$, m.p. 291°, on drastic oxidation with aqueous alkaline permanganate gave albeit in low yield and 3, 4-methylenedioxybenzoic acid, identical with an authentic sample (Govindachari *et al.* 1967*b*).

Ellagic acid, diphyllin and two new lignan lactones, collinusin and cleistanthin have been isolated from *C. collinus*. The major constituent of the leaves was a highly toxic glycoside, cleistanthin, m.p. 135-136°, $C_{28}H_{28}O_{11}.H_2O$. Its NMR spectrum showed the presence of five aromatic protons, a methylenedioxy group, a methylene and four methoxyls (Govindachari *et al.*, 1969).

**Pharmacology :** Cleistanthin, a new glycoside isolated from the acetone extract of the leaves, produced consistent increase of neutrophilic granulocyte count (NGC)

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on administration by various routes in rats, mice, cats and monkeys. The rise in NGC was noticed after single oral dose which persisted up to 72-120 hours in different species. i.p. and i.v. injections of the glycoside resulted in remarkable increase of NGC by 6 hours after injection which reached to normal values in 24 hours. Repeated administration of 0·25 mg./kg./day orally to rats for 30 days maintained the neutrophilic count at a high level without any toxic side effect. Granulocytopenia induced by I.P. injection of cyclophosphamide could be prevented by the glycoside. $LD_{50}$ (oral) was 12 mg./kg. and the therapeutic index was found to be 12 mg./kg. in rats (Rao and Nair 1970*a*, *b*).

Leucopenia was induced in rats (70 mg./kg.) and mice (200 mg./kg.) by a single i.p. injection of cyclophosphamide and after oral dose of 2·5 mg./kg. of cleistanthin, the NGC was significantly higher, six to seven times more than that of control rats (Rao and Nair, 1971).

The alcoholic extract of the whole plant *C. collinus* showed anti-cancer activity against human epidermal carcinoma of the nasopharynx in tissue culture (Bhakuni *et al.*, 1969).

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# CLEOME (Capparidaceae)

*C. CHELIDONNI* Linn.

**Habitat :** Occurs as a weed in clay and black cotton soil in northern Circars and Bombay.

**Parts used :** Whole plant and root.

**Medicinal properties and uses :** Infusion of the plant is used in gingivitis and skin diseases. Root is used as a vermifuge in Indo-China (Chopra *et al.*, 1956).

*C. VISCOSA* Linn. (Syn. *C. icosandra* Linn.).

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Tilparni | Mar. | — | Aryaval |
| Eng. | — | Wild or Dog mustard | Punj. | — | Bogra |
| Guj. | — | Tilvan | Tam. | — | Nayi-velai |
| Kan. | — | Kaadusaasive | Tel. | — | Naelanaminta |
| Kon. | — | Sirikala | | | |

**Habitat :** A common weed found all over the plains of India and plentiful in Bengal and the Gangetic valley.

**Parts used :** Whole plant, seeds, leaves and root.

**Ayurvedic description**

Sanskrit : *Ajagandha*

Synonyms : *Ugragandha, tilaparni, karnapotha*

Properties : *Rasa* — *Katu*
*Guna* — *Rooksha, laghu, teekshna*
*Veerya* — *Ushna*
*Vipaaka* — *Katu*

Actions/Uses : *Agnideepana, ruchya, hridya, gulmaghna, udararogaghna, karnavranahara, karnaartihara, karnashoolaghna, krimighna, jwaraghna.*

**Medicinal properties and uses :** Seeds are carminative, anthelmintic and antiseptic. Juice of the leaves is sudorific. Leaves have a pungent flavour and bark is irritant and acrid; externally it is rubefacient and vesicant. When cooked it looses its acrid properties (Nadkarni, 1954).

**Pharmacognosy :** Pharmacognostic studies of leaf and seed of *C. viscosa* have been carried out.

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Macroscopic characters : The leaf is palmately compound, the leaflets being covered with glandular trichomes and these have a saltish, bitter taste and a strong odour.

Seeds are brownish black, dorsally compressed and seed coat is striated, the striations forming a net-like structure.

Microscopic characters : In transection the petiole shows a C shaped structure with a groove on the dorsal side. In the lamina, upper and lower epidermis have rectangular cells with trichomes on them. Stomata of ranunculaceous type are present on both the surfaces. In midrib, the cells of the upper epidermis are smaller than those of the lamina and have numerous trichomes which are of glandular, seriate and multiseriate type.

The seed in transection appears as a bean shaped structure having dark brown seed coat. Endosperm is present and the mature embryo is curved (Puri, 1971).

**Chemistry :** The petroleum ether extract of the leaves of *C. viscosa* gave positive test for sterols. Ethanol extract gave positive tests for alkaloids and tannins. The seeds when extracted with petroleum ether yielded a yellow coloured fatty oil. The water extract gave a strong positive test for saponins. Alkaloids and tannins were not present in the seeds (Puri, 1971).

Rutin was isolated from the flowers of *C. chelidonni*. The yield was 3 per cent and the flowers were considered a good source for rutin, a bioflavonoid with medicinal properties (Subramanian *et al.*, 1965).

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## CLERODENDRON (Verbenaceae)

*C. INFORTUNATUM* Gaertn.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Bhat | Punj. | — | Kalibasut |
| Hind. | — | Bhant | Sans. | — | Bhandira |
| Kan. | — | Nayi-bela | Tam. | — | Angaara |
| Mar. | — | Kari | Tel. | — | Bakada |

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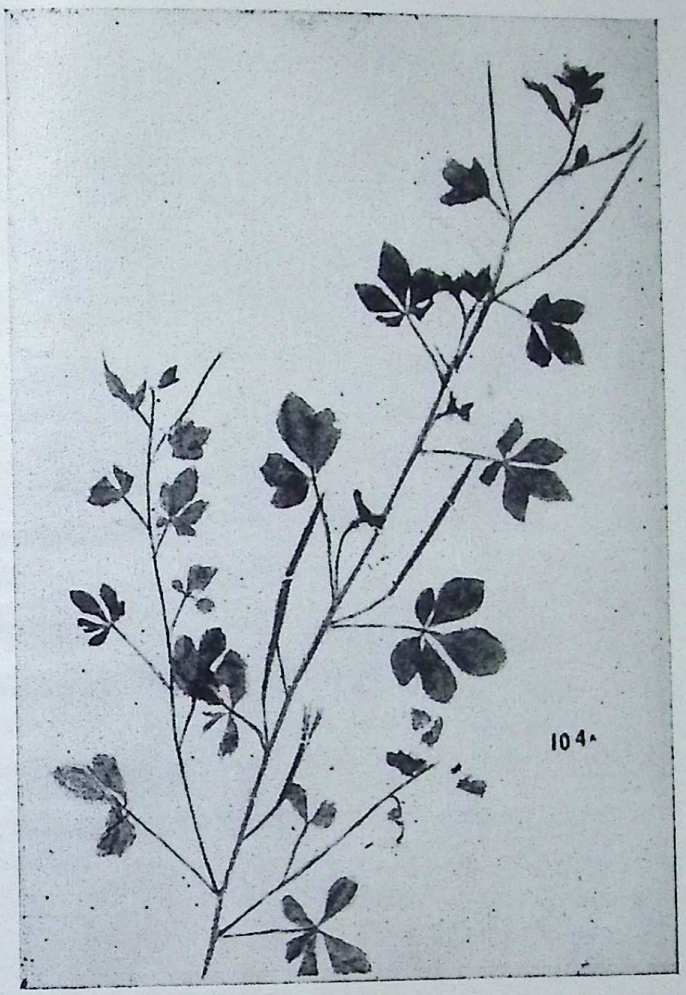


*Cleome viscosa*

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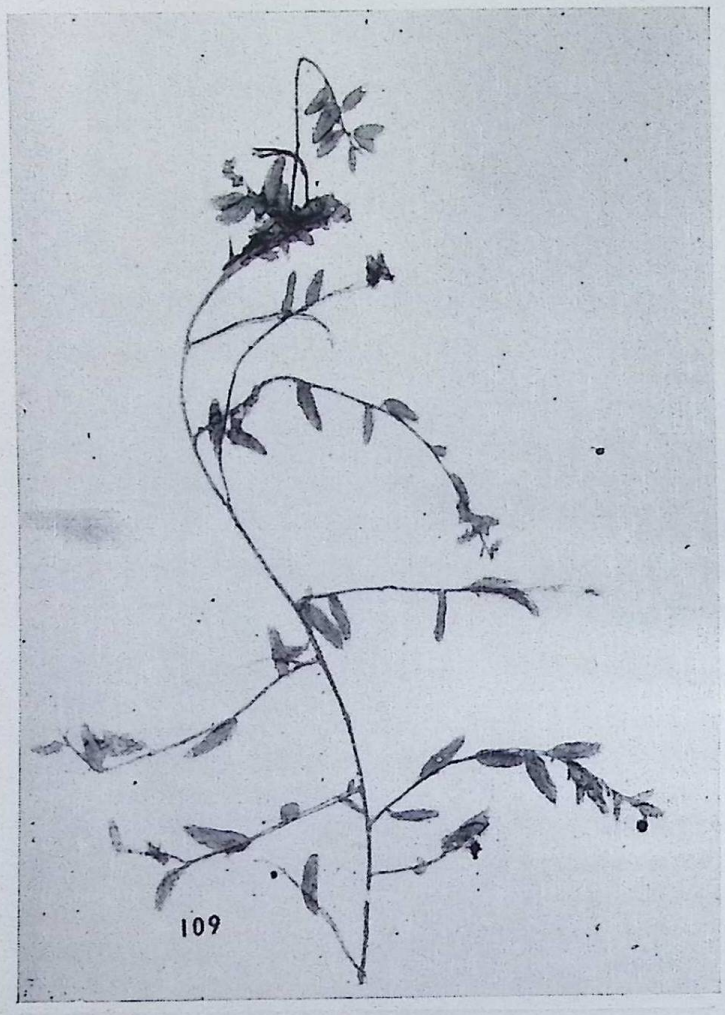


*Cocculus hirsutus*

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**Habitat :** It is an under shrub found in central India and Ceylon.

**Parts used :** Leaves.

**Medicinal properties and uses :** Leaves have a very disagreeable odour and are used as a bitter tonic and antiperiodic, in malaria and after attacks of ague and also as vermifuge. Expressed juice of the leaves is laxative, cholagogue and anthelmintic. Decoction of leaves is used as an anthelmintic in round worm infestation. Root rubbed down with butter milk, is given in colic. The drug is also used in scorpion-sting and snake-bite (Nadkarni, 1954).

*C. PHLOMIDIS* Linn.

| | | | | | |
|---|---|---|---|---|---|
| Guj. | — | Arani | Mar. | — | Takali |
| Hind. | — | Urani | Tam. | — | Taaludalai |

**Habitat :** It is found in the Gangetic valley.

**Parts used :** Leaves and roots.

**Ayurvedic description**

Sanskrit : *Agnimantha*

Synonyms : *Jaya, jayanti, shreeparna, agnikaarika, vaataghni, tarkari, vaijayantika*

Properties :
*Rasa* — *Tikta, katu, kashaaya, madhura*
*Guna* — *Rooksha, laghu*
*Veerya* — *Ushna*
*Vipaaka* — *Katu*

Actions/Uses : *Shwaasaghna, paandughna, agnimandyaghna, vibandhahara, shothaghna*

**Medicinal properties and uses :** Juice of leaves is used as an alterative and bitter tonic, decoction of its root is slightly aromatic and astringent and used as a demulcent in gonorrhoea. It is also given to children during convalescence from measles. This is one of the five roots, in *Brihat Panchamooli.* It is one of the components of a group of ten roots known as *Dashmool* which is used for a number of ailments (Nadkarni, 1954).

C. *SERRATUM* (Linn.) Moon.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Bamanhati | Mal. | — | Cheruteku |
| Hind. | — | Bharangi | Tam. | — | Cheruteku |
| Kan. | — | Bharangi, gantuparangi | | | |

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**Habitat :** Found in eastern India, especially Bengal.

**Parts used :** Root.

**Ayurvedic description**

| | |
|---|---|
| Sanskrit : | *Bhaarangi* |
| Synonyms : | *Braahmanayasht'ka, kharashaaka, padma, bhrigubhava, phanjee* |
| Properties : | *Rasa* — *Tikta, katu, kashaaya*<br>*Guna* — *Laghu, rooksha*<br>*Veerya* — *Ushna*<br>*Vipaaka* — *Katu* |
| Actions/Uses : | *Deepana, paachana, shothahara, kaasashwaasavinaashini, vranaghna, krimighna, daahajwaranivaarini, gulmahara* |

**Medicinal properties and uses :** Root is used in the form of decoction as a remedy in asthma, bronchitis and other catarrhal affections of the lungs. The leaves are applied in the form of poultice to hasten suppuration. The drug is used in snake-bite and fever (Nadkarni, 1954).

**Pharmacognosy :** Pharmacognostic studies of *C. phlomidis* and *C. serratum* have been carried out.

Macroscopic characters—The leaves of *C. phlomidis* are simple, opposite, ex-stipulate, broadly ovate, petiolate puberlous with crenate margin. In young plants they are much larger while very small ones occur on and near the panicle of old stems.

Microscopic characters—Leaf is dorsiventral with one to two or three layers of palisade cells. Both glandular and non-glandular hairs are present. Stomata are cruciferous. Palisade ratio is 2·4, stomatal index 8·26 (upper), 10·29 (lower), vein-islet number 11 and vienlet termination number 17 (Chunekar and Raghunathan, 1967).

Three commercial samples procured as *agnimantha* from different places have been shown to be entirely different from the stem of *C. phlomidis*, anatomically. The distinguishing characters of different samples have been recorded. The pharmacognostic characters of the leaves of *C. phlomidis* have also been recorded (Krishnamurthy *et al.*, 1972).

The root of *C. serratum* is characterised by a stratified cork, secondary phloem, interspersed with sclereids and ring porous xylem. Starch grains occur in xylem rays and xylem parenchyma and are similar in character to those found in the phloem parenchyma. Acicular crystals of calcium oxalate are scattered in the xylem rays and xylem parenchyma cells. Powder is yellowish brown in colour with pungent odour and an acrid taste.

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The leaf shows a few uniseriate covering trichomes around the margin and over the large veins and occasional glandular trichomes on both the surfaces. The vascular bundles capped with groups of fibres are seen in a more or less continuous cylinder at the basal region of the midrib and are gradually reduced to a single strand at the apex (Bisht and Kundu, 1962).

A detailed pharamacognostic study of the roots of *C. serratum* and *C. indicum* showed certain differences in their characters. In *C. serratum*, the primary root is tetrarch to pentarch and the cork cambium arises in the second layer of cortex giving rise to a stratified cork, 16 to 20 cells thick. The xylem fibres are long with pointed, forked or libriform ends. Starch is absent. In *C. indicum* the primary root is tetrarch to octarch, the cork cambium arises in the pericycle giving rise to a non-stratified cork, 3 to 5 layers of cells thick. The bark remains thin throughout unlike *C. serratum* in which it is thick. The xylem fibres are short and pointed and rarely with forked ends. Starch is present throughout the parenchyma tissue (Prasad *et al.*, 1967).

**Chemistry :** From the alcoholic extract of the roots of *C. infortunatum*, a crystalline sterol glucoside, m.p. 285-90° was isolated. The glucoside was found to be a mixture of two closely related compounds. They were shown to be glucosides of β-sitosterol and $\Delta^5$, 25-stigmastadien 3-β-ol. They could not be separated (Barva *et al.*, 1967).

The powdered stem of *C. phlomidis* contained D-mannitol, β-D glucoside of β-sitosterol, β-sitosterol and ceryl alcohol. The total extract on concentration at room temperature gave a crystalline deposit, which on acetylation with acetic anhydride and fused sodium acetate, furnished mannitol hexaacetate, m.p. 119°. β-D-glucoside of β-sitosterol was obtained as colourless needles m.p. 292-94°. The mother liquor after the removal of β-D-glucoside of β-sitosterol on further concentration yielded β-sitosterol. The subsequent alcoholic extractive was further extracted with ether, which on chromatography gave white flakes, m.p. 72-74°. The compound analysed for $C_{26}H_{50}O$ and was identified as ceryl alcohol (Gupta *et al.*, 1967*a*).

Chemical examination of the root bark of *C. serratum* yielded a glycosidic material which was phenolic in nature. The powdered bark after being extracted with water gave a crystalline compound as well as a sticky brown residue. The crystalline product had m.p. 162-164°. The glycosidic matter of the root bark yielded, on hydrolysis, a crystalline residue most of which was soluble in 2 per cent caustic soda solution indicating the acidic (or phenolic) nature of the product (Sachdev *et al.*, 1965).

D-mannitol, $C_6H_{14}O_6$, m.p. 166°, was isolated from the root-bark of *C. serratum* in a yield of 10·9 per cent (Verma *et al.* 1967). The petroleum ether extract of the air dried powdered root-bark of *C. serratum* yielded α-sitosterol, $C_{29}H_{50}O$ (Vasavada *et al.*, 1967).

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The sapogenin mixture obtained from the bark of *C. serratum* has been found to contain three major triterpenoid constituents, oleanolic acid, queretaroic acid and a new acid named as serratagenic acid of which the structure has been established. (Rangaswami and Sarangan, 1969).

**Pharmacology :** The alcoholic extract of *C. infortunatum* produced vasodilation due to a parasympathomimetic action. The aqueous extract also produced vasodilation and spasmogenic action on rabbit duodenum. The aqueous extract showed anthelmintic activity against *Ascaridia galli* (Maurya *et al.*, 1971).

The alcoholic extract of whole plant *C. infortunatum* was found to have hypoglycaemic activity in albino rats. The extract also showed antiprotozoal activity against *Entamoeba histolytica* (Dhar *et al.*, 1968).

The aqueous extract of the leaves of *C. phlomidis* administered intramuscularly was found effective in reducing the oedema of formalin-induced arthritis in rats. External application of the alcoholic extract of the leaf also reduced the oedema (Krishnamurthy *et al.*, 1972).

The alcoholic extract and the saponin isolated from the root bark of *C. serratum* caused release of histamine from the lung tissue. Prolonged administration of the saponin in 20 mg./kg. dose caused significant depletion of histamine from the lungs of rats treated with the drug. The saponin, like other histamine releasers, did not manifest any anti-histaminic activity or give any protection against acute anaphylactic shock in sensitized guineapigs exposed to egg albumin micro-aerosols. However, the continued daily administration of the drug (20 mg./kg.) for 20 days to sensitized guineapigs was found to cause a gradually developing protection against anaphylaxis. The lung extract from treated animals showed antihistaminic activity on isolated guineapig ileum (Gupta and Gupta, 1967; Gupta *et al.*, 1967*b*; Gupta, 1968).

The dried water extract of the plant was effective in producing a graded block of the responses of histamine on the guineapig ileum. It also blocked the histamine induced contractions of the guineapig trachea without affecting the contractions produced by acetylcholine. On intravenous administration in a dose of 0·5-1 g./kg., the aqueous extract partially blocked the responses to histamine on the blood pressure of dog but did not affect the responses to acetylcholine and adrenaline (Sachdev *et al.*, 1964).

On intraperitoneal administration of 0·3 mg./kg. of saponin in rabbit, the average pseudo-cholinesterase activity of 45·25±2·5 unit was found to decrease to about 50 per cent and the effect was similar to that observed after 0·04 mg./kg. of physostigmine. In the *in vitro* studies, the saponin in graded concentration, inhibited the cholinesterase

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activity of rabbit serum in proportion to the increasing concentrations and an inhibition in cholinesterase activity to the extent of about 50 per cent was observed after $2\times10^{-5}$ and $10^{-6}$ concentrations of saponin and physostigmine respectively. The anti-cholinesterase activity of the saponin was also confirmed by acetylcholine responses on guineapig tracheal chain preparation, isolated rat ileum and frog rectus muscles (Modh and Gupta, 1969).

The saponin also caused a disruption of mast cells of the rat mesentery which was proportional to the dose up to a concentration of $4\times10^{-5}$. The maximum disrupting effect was achieved in 30 minutes. In low concentrations, it blocked the mast cell disrupting effect of compound 48/80 and an antigen derived from horse serum (Gupta *et al.*, 1971).

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## CLITORIA (Papilionaceae)

*C. TERNATEA* Linn.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Nila-aparajita | Mal. | — | Aral, shankapuspam |
| Eng. | — | Butterflypea | Mar. | — | Gokurna-mula |
| Guj. | — | Garani | Tam. | — | Kodi-kakkanam, shanupushpam |
| Hind. | — | Aparajita | | | |
| Kan. | — | Shankapushpa | Tel. | — | Dintana |
| Kon. | — | Shankaspushipi | | | |

**Habitat :** A common garden plant found all over India, specially in south India.

**Parts used :** Root, bark, seeds and leaves.

**Ayurvedic description**

Sanskrit : *Vishnukraanta*

Synonyms : *Ashphota, girikarnikaa, aparaajita, saphalee, bhoordisham, satheenika, neelapushpa, neelaadrikarnee, danikee, ksheerika, jaya*

Properties : *Rasa* — *Kashaaya, katu, tikta*
*Guna* — *Laghu*
*Veerya* — *Sheeta*
*Vipaaka* — *Katu* (*tikta* ?).

Actions/Uses : *Kanthya, buddhiprada, smritiparda, medhakara, chakshushya, rujaapaha ; mootradoshahara, aamadoshaghni, kushtaghna, vranaghna, vishaghna, netravikaarashamanee, raktaateesarashamanee, jwaraghna, daahaghna, unmaadahara, bhramaghna.*

**Medicinal properties and uses :** Fresh root has an acrid, bitter taste and is aperient, laxative and diuretic. Seeds have a powerful cathartic action. Root bark is demulcent, diuretic and also laxative (Nadkarni, 1954).

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**Chemistry*** : The isolation of taraxerol from the petroleum ether extract of the root of *C. ternatea* was reported previously. Another product has been isolated in small amount using a mixture of solvents in different proportions. The crystalline product obtained had m.p. 239-241° and corresponded to the molecular formula $C_{30}H_{48}O$. This compound has been identified as taraxerone by comparison with the authentic sample (Banerjee and Chakravarti, 1964).

**Reference**

Banerjee, S.K. and Chakravarti, R.N. 1964. Taraxerone from *Clitoria ternatea* Linn. **Bull Calcutta Sch Trop Med 12,** 23.

## COCCINIA (Cucurbitaceae)

*C. INDICA* Wight and Arn. (Syn. *C. grandis* (Linn.) Voigt, *C. cordifolia* Cogn.)

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Tala-kucha | Mar. | — | Ran-tondala |
| Guj. | — | Gholi | Punj. | — | Kanduri |
| Hind. | — | Kanduriki-bel | Tam. | — | Kovaikkodi |
| Kan. | — | Tondekayee | Tel. | — | Dondatiga |
| Mal. | — | Kova | | | |

**Habitat :** Grows in wild state abundantly in Bengal and in other parts of India.

**Parts used :** Leaves, root, fruit and bark.

**Ayurvedic description**

Sanskrit : *Bimbee*

Synonyms : *Tundee, tundikeree, raktaphala, dantachchada, choshnaphala, vidruma, titidee, tundikeraphala, vidrumaphala, peeluparnikaa*

Properties : General : *Rasa* — *Madhura, tikta, kashaaya*
*Guna* — *Laghu, rooksha, teekshna*
*Veerya* — *Ushna*
*Vipaaka* — *Katu* (*madhura* ?)

Actions/Uses : General : *Vranaropana, shothahara, deepanee, vamanahara, rechanee, mootrasangrahaneeya, swedakaree, jwaraghna*

*No report available on other aspects.

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| | | |
|---|---|---|
| Branches : | *Rasa* | — *Madhura, tikta, kashaaya,* |
| | *Guna* | — *Laghu* |
| | *Veerya* | — *Sheeta* |
| | *Vipaaka* | — *Katu* |
| Action/Uses : | *Sangraahee, kaamalaapaha* | |
| Fruits : | *Rasa* | — *Madhura* |
| | *Guna, Veerya, and Vipaaka*—Not described | |
| Actions/Uses : | *Shophaghna, paanduhara, stambhana, aadhmaanakaree, vibandhakaree.* | |

**Medicinal properties and uses :** The dried bark is a good cathartic. Leaves and stem are antispasmodic and expectorant. The fleshy green fruit is very bitter but when ripe it is sweet. The plant has the reputation in Bengal of having a remarkable effect in reducing the amount of sugar in the urine of patients suffering from diabetes mellitus. It has been described by some as the Indian substitute for insulin. The green juice extracted from the plant was tried in some of the surgical cases suffering from glycosuria in the Calcutta Medical College Hospital, with beneficial results. The quantity of sugar was said to be greatly reduced and in some cases to have entirely disappeared (Nadkarni, 1954).

**Pharmacognosy :** Pharmacognostic studies of the root and leaf have been carried out.

*Root*—Macroscopic characters : The fresh tap root is thick, tuberous, long, tapering, more or less tortuous with a few fibrous rootlets attached to it. The roots are flexible and soft and break with a fibrous fracture.

Microscopic characters : A transection of the root shows circular outline and is characteristic of the storage type. The parenchyma is full of starch grains and thorough permeation of parenchyma with vascular elements is observed. The cork is composed of 6 rows of cells. Phellogen is not distinct while phelloderm consists of 3-4 rows of cells. A few scattered groups of pericyclic fibres and some stone cells are present. The primary xylem is tetrarch, pentarch or hexarch in various roots and is readily visible near the centre of the root surrounded by secondary xylem. Occasionally tyloses is found in some vessels. Powder of the roots is yellowish-white in colour.

*Leaf*—Macroscopic characters : The leaves are studded with numerous small round discs or papillae above. They are palmately 5-nerved from a cordate base.

Microscopic characters : A transverse section of the leaf lamina shows an upper epidermis covered with cuticle and having layer of polygonal cells with wavy walls. Numerous stalkless glands chiefly with bicellular heads are found in the depressions

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of the upper epidermis. Stomata of ranunculaceous type are numerous only on the lower surface. Covering trichomes occur around the margin of the leaf and are uniseriate, multicellular and broad at base.

A transection through the midrib shows a few rows of collenchyma bordering the epidermal cells. The xylem is well developed and consists of lignified annular and spirally thickened elements. The palisade ratio, stomatal index and vein-islet number have been determined. The powder of the leaf is green in colour (Bisht and Nayar, 1958).

**Pharmacology :** A hypoglycaemic activity was earlier reported in this plant (Trivedi, 1956). Linear-dose effect relationship was established when log doses were plotted against the effect as percentage of tolbutamide activity (Brahmachari and Augusti, 1962). Its effect on blood sugar was later confirmed (Mukherjee *et al.*, 1963).

The water soluble fraction of the alcoholic extract of the roots revealed hypoglycemic properties in alloxan diabetic rabbits. The studies were conducted on experimentally produced alloxan diabetes in rabbits for a period of 58 to 71 days. Glycosuria disappeared and significant improvement in the general diabetic state was noticed. The improvement lasted for 21-34 days during which the animals were kept under observation following cessation of treatment (De and Mukerji, 1953). The plant extract also caused appreciable inhibition of the hypoglycaemic response of the anterior pituitary extract in glucose-fed albino rats (Gupta, 1963).

The effect of parenteral administration of the alcoholic extract of the plant on hyperglycaemic response of diabetogenic hormones, somatotropin and corticotropin has been studied in albino rats. Hyperglycaemia induced by somatotropin and corticotropin was reduced by the drug (Gupta and Variyar, 1964).

A quarternary base isolated from the plant was also found to possess hypoglycaemic activity of short duration and it showed definite activity on glucose tolerance test in normal guineapigs. The drug had a moderate hypoglycaemic activity in alloxan diabetic rats (Mukherjee *et al.*, 1972).

Screening of this plant at CDRI, Lucknow, however, did not reveal any hypoglycaemic activity of the root extract. However, it has been reported to possess anti-protozoal properties against *Entamoeba histolytica* (Bhakuni *et al.*, 1969).

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## COCCULUS (Menispermaceae)

*C. HIRSUTUS* (Linn.) Diels.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Huyer | Tam. | — | Kaattukkodi |
| Hind. | — | Jamtikibel | Tel. | — | Dusaraitige |
| Mar. | — | Vasanvel | | | |

**Habitat :** Found in tropical and subtropical India from Himalayas to south India.

**Parts used :** Roots and leaves.

**Ayurvedic description**

Sanskrit : *Paataalagarudee*

Synonyms : *Garudee, vatsaadanee, deerghavallee*

Properties :
*Rasa* — *Madhura* (*Katu* ? *tikta* ?)
*Guna* — *Laghu,* (*snigdha* ? *pichchila* ?)
*Veerya* — *Ushna*
*Vipaaka* — *Katu*

Actions/Uses : *Deepanee, paachanee, anulomanee, raktadoshaghni, santarpanee, ruchya, vishadoshahara, paramavrishya*

**Medicinal properties and uses :** Root is refrigerant, laxative, sudorific, alterative and is also useful in chronic rheumatism and venereal diseases. Juice of leaves when mixed

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with water forms a jelly which is taken as a cooling medicine for gonorrhoea and used externally for eczema, prurigo and impetigo (Chopra *et al.*, 1956).

*C. PENDULUS* (Forsk.) Diels (Syn. *C. leaeba* DC.)

Guj. — Parwatti
Punj. — Illarbillar
Tel. — Dusaratige

**Habitat** : Occurs wild in Sind, Baluchistan, Waziristan, Punjab, Kathiawar, Deccan and Karnataka down to Tinnevelly.

**Parts used :** Root.

**Medicinal properties and uses :** Roots are used in the treatment of intermittent fevers and as a tonic (Chopra *et al.*, 1956).

**Chemistry :** A new biscoclaurine base designated as pendulin, $C_{37}H_{40}N_2O_6$, m.p. 192-194°, has been isolated from the stem and leaf of *C. pendulus*. Pendulin formed a hydrochloride having m.p. 276-278°, a picrate with m.p. 210-212° and a dimethiodide having m.p. 282-286° (Gupta *et al.*, 1970).

A new benzyl isoquinoline alkaloid designated as cocsulin was isolated from the stem and leaves of *C. pendulus* and had molecular formula $C_{35}H_{34}N_2O_5$, m.p. 272-274°; it formed a picrate having m.p. 194-196°. The structure of cocsulin has also been elucidated (Bhakuni *et al.*, 1970).

**Pharmacology :** The water-soluble fraction of the ammoniacal ethanolic extract of *C. hirsutus* was found to contain alkaloids. The effects of the alkaloidal solution were compared with those of the total extract. The alkaloidal solution produced moderate to marked hypotension of prolonged duration in dogs without any significant effect on respiration. It was found to be a more potent hypotensive agent compared to the total extract, but the former showed tachyphylaxis. Atropine did not alter the hypotensive effect of the alkaloidal solution. Hypotension was also observed in unanaesthetized rabbits by intraperitoneal and intravenous administration of alkaloidal solution. It inhibited the carotid baroreceptor reflex. Both the alkaloidal solution and the total extract reduced the amplitude of myocardial contractions in dog. The alkaloidal solution after a latent period of 5-10 minutes produced a slowly developing spasm of dog's ileum *in situ*.

Both the alkaloidal solution and the total extract showed positive inotropic activity on isolated perfused frog heart. They also showed cardiotonic activity in hypodynamic heart, the activity of alkaloidal solution being 5 times more potent than that of the total extract. The activity of alkaloidal solution was comparable to that of 50-100 µg. of digoxin.

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The alkaloidal solution had a slight stimulating effect on isolated rabbit ileum which was unaffected by atropine. It had relaxant and antispasmodic activities in rat ileum. It had a stimulating effect on the uterus of albino rat. The drug inhibited the acetyl choline-induced response on frog rectus abdominis muscle. The drug was non-toxic up to high doses *i.e.* 40 mg./kg. intravenously in dogs and 100 mg./kg. orally in rabbits and albino rats (Das *et al.*, 1964; Nath, 1964).

The alcoholic extract of the aerial parts of *C. pendulus* was found to have anti-cancer activity against human epidermal carcinoma of the nasopharymx in tissue culture. The extract also possessed anti-viral activity against *Ranikhet disease virus* (Bhakuni *et al.*, 1969).

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## COCOS (Palmae)

*C. NUCIFERA* Linn.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Narikel | Kon. | — | Narla-maddo |
| Eng. | — | Coconut palm | Mal. | — | Tengu |
| Guj. | — | Naliar | Mar. | — | Naral |
| Hind. | — | Nariyal | Tam. | — | Tengu, tennaimaram |
| Kan. | — | Tengu | Tel. | — | Tenkayichettu |

**Habitat :** Extensively cultivated in southern India and Ceylon. It is not found in the northern provinces, but is plentiful in eastern Bengal, Burma, in Malabar and Coromandal coasts and the islands of the Indian Archipelago.

**Parts used :** Flowers, root, fruit, oil and ash.

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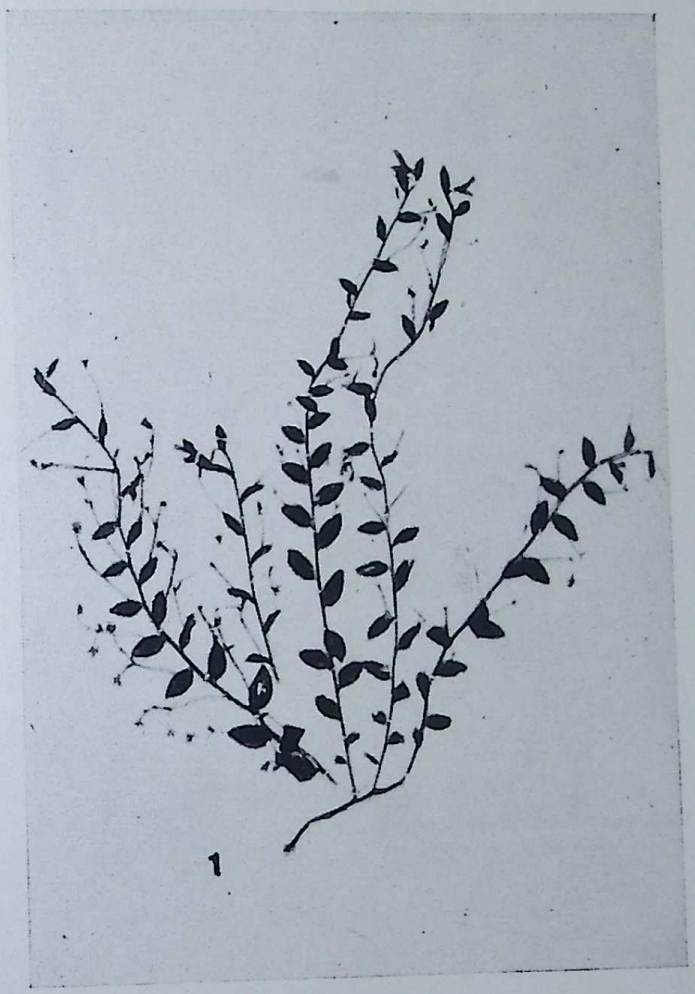


*Abroma augusta*

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*Abrus precatorius*

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**Ayurvedic description**

Sanskrit : *Naareekela*

Synonyms : *drudhabeeja, maahaphala, tunga, skandhaphala, drudhavriksha, drudhaphala, lanalee, koorchakesara, daakshinaatya, sadaaphala, toyagarbha, pootodakam, vastuphala, deerghaphala*

Properties :
- *Rasa* — *Madhura*
- *Guna* — *Guru, snigdha*
- *Veerya* — *Sheeta*
- *Vipaaka* — *Madhura*

Actions/Uses :
- General : *Daahashamanee, keshya, vranaropana, anulomani, deepanee, shoolaprashamanee, raktapittaprashamanee, hikkaghna, mootrala, mootravirechanee, vastishodhanee, vaajeekara, brihmana, aartawajananee, balya, jwaraghna, hridya, vishtambhi, tarpana, preenana, maamsakara, vrishya, kshatakshayashamanee*
- Coconut water : *Sheeta, snigdha, madhura, vastishodhanee, deepanee, shukrala, hridya, laghu, trishnaashamanee, daahashamanee*
- Oil : *Brihmana, balya, keshya, dantya, madhura*
- Flower : *Raktapittashamanee, pramehashamanee, raktaateesaaraghna, somarogaghna, deepanee*

**Medicinal properties and uses :** Coconut milk is refrigerant, nutrient, aperient, diuretic and anthelmintic. Coconut water is cooling, refrigerant, demulcent and in large doses aperient. Fresh kernel or tender pulp is nourishing, cooling, diuretic and refrigerant. Terminal buds are nourishing and digestive. Their fresh juice is refrigerant and diuretic. Fermented juice constitutes the spirituous liquor called toddy and it is refreshing and laxative. Oil from the shell is rubefacient and antiseptic and is also used for external application. Root is diuretic (Nadkarni, 1954).

**Pharmacological and clinical studies :** A polysaccharide factor isolated from coconut water when injected into mice, induced a moderate but statistically significant degree of resistance to experimental tuberculosis. The factor also produced an antigen-antibody reaction with serum from tuberculosis-infected guineapigs, thus indicating the factor to be immunogenic (Malathi *et al.*, 1959).

The extracts of the shell fibres of *C. nucifera* were studied for their anti-microbial activity against *S. aureus, S. pyogenes, B. subtilis, S. typhi, E. coli, P. vulgaris, K. pneumonia* and *P. aeruginosa.* The crude extracts did not show any activity but the crude drug on pyrolysis yielded three fractions at different temperatures *viz.* (*i*) 130-138°, (*ii*) 160-240° and (*iii*) 270-360°. Fraction (*ii*) had the highest activity and on further purification with ether, it yielded on oily liquid. The activity was found to be due to the oily liquid and not the aqueous portion. The oily liquid from fraction (*ii*) was also found to be

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highly active against six types of fungal organisms *viz. Aspergillus niger, Penicillium chrysogenum, Candida albicans, Trichophyton mentagrophytes, Rhizoctonia solani and R. bataticola* (Gaind and Singla, 1968).

Coconut water infused intravenously at 40-110 ml./kg. body weight and at the rate of 7 to 9 ml. per minute in dogs caused an initial significant increase in frequency and amplitude of respiration and slowed the heart rate. Blood pressure showed a sustained increase in dogs except in those associated with ECG abnormalities. Coconut water also caused a significant increase in the urine output of dogs (Suresh and Hegde, 1970).

The effect of coconut water in ten cases of congestive cardiac failure with peripheral oedema was studied. Five cases were treated with coconut water regime and the other five cases with Karrel's regime. The series on coconut water regime responded much better in comparison to the series on Karrel's regime as judged by the improvement of clinical signs, urine output, weight loss and urinary excretion of sodium (Shah *et al.*, 1956).

A comparative study of intravenous use of natural coconut water, synthetic coconut water and glucose saline in gastric enteritis was carried out in 40 patients. A total of 45 infusions were given, 16 being of natural coconut water, 14 of synthetic and 15 of glucose saline. An average quantity of infusion required to correct dehydration and prostration was found to be 432·1 ml. of natural coconut water, 612·5 ml. synthetic coconut water and 1910·7 ml. glucose saline. No significant change in serum electrolytes was observed at the end of the infusion (Acharya *et al.*, 1965).

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## COLOCASIA (Araceae)

*C. ESCULENTA* (Linn.) Schott. (Syn. *C. antiquorum* Schott.)

| | | | |
|---|---|---|---|
| Ben. and Sans. | — Kachu | Mar. | — Kachualu |
| Hind. | — Arvi | Tam. | — Sheppan-kizangu |
| Mal. | — Shembu | Tel. | — Chamadumpa |

**Habitat :** Found wild on the banks of streams, ponds and marshes and in moist and shady situations inside forests in many parts of India up to an elevation of 2,600 m.

**Parts used :** Petioles and corm.

**Medicinal properties and uses :** Juice of petioles is styptic, stimulant, rubefacient whereas juice of corm is used in cases of alopecia and in scorpion sting (Chopra *et al.*, 1956).

**Chemistry* :** Mucilagenous matter of corm and tuber of *C. esculenta* has been isolated by using boiling water. The yield was 4·0 per cent and 10·7 per cent from corm and tuber respectively and their emulsifying properties were studied. The mucilage was comparable with acacia as emulsifying agent and some of their emulsions were better than acacia. The HLB values of corms and tuber mucilages have been found to be 9·54 and 9·91 respectively (Gaind *et al.*, 1968).

The binding properties of mucilages of corm and tuber of *C. esculenta* compared well with mucilages of acacia, starch and methyl cellulose in tablets of sodium bicarbonate, sulphanilamide, phenobarbitone sodium and aspirin-phenacetin-caffeine. Dissolution profiles of such tablets have also been studied (Gaind *et al.*, 1969).

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## COMMIPHORA (Burseraceae)

*C. MUKUL* (Hooker Stedor) Engl. (Syn. *Balsamodendron mukul* Hook.)

| | | | |
|---|---|---|---|
| Ben. | — Guggul | Hind. | — Gugal |
| Eng. | — Indian bedellium | Kan. | — Guggulu |
| Guj. | — Gugara | Tam. | — Kukkulu, guggulu |
| | | Tel. | — Gukkulu, Guggulu |

*No report available on other aspects.

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**Habitat :** The tree grows in Sind, Rajasthan, Bangla Desh, Hyderabad, Assam, Madhya Pradesh and Karnataka.

**Parts used :** Gum-resin.

**Ayurvedic description**

Sanskrit : *Guggulu*

Synonyms : *Palankasha, kaushika, puraa, mahishaaksha, sugandhi, kumbha, ulookhala, sulaghu, devadhooma.*

Properties :

| | | |
|---|---|---|
| *Rasa* | — | *Tikta, katu, madhura, kashaaya* |
| *Guna* | — | *Laghu, teekshna, snigdha, pichchila, vishada, sookshma, sara* |
| *Veerya* | — | *Ushna* |
| *Vipaaka* | — | *Katu* |

Actions/Uses : Fresh Guggulu : *Brihmana, vrishya*

Old Guggulu : *Atilekhana, hridya, bhagnasandhaanakara, swarya, rasaayana, deepani, balya, vranaghna, apacheeghna, granthighna, gandamaalaahara, medoghna, mehaghna, ashmaghna, kledakushtaprashamanee, pidakaghana, krimighna.*

**Medicinal properties and uses :** When fresh, the oleo-gum-resin is moist, viscid, fragrant and of golden colour. It burns in fire, melts in the sun and forms a milky emulsion with hot water. The pharmacological action of the gum-resin resembles in many ways the action of copiaba and cubeb. It has no action on the unbroken skin, but on the abraded skin and the mucous membranes, it acts as an astringent and antiseptic. When taken internally it is reported to possess appetising, carminative, antispasmodic, diaphoretic, ecbolic, anti-suppurative, aphrodisiac and emmenagogue properties. It is a non-toxic drug and the only side effects reported are rashes and mild kidney irritation which disappear on withdrawal of the drug (Nadkarni, 1954).

**Chemistry :** The gum resin of *C. mukul* was found to contain 4·6 per cent foreign impurities, 32 per cent gum, 19·5 per cent mineral matter consisting chiefly of silicon dioxide, calcium, magnesium, iron and aluminium. It also contained 1·45 per cent essential oil (Ghosh, 1942). The essential oil was found to contain 6·4 per cent myrcene, 11 per cent dimyrcene and some polymyrcene. The other characteristics of the oil have been recorded (Bhati, 1950).

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On systematic chromatographic separation, the petroleum ether extract of the gum-resin yielded sesamin, cholesterol and a few other steroids (Sukhdev, 1970).

Guggulu, has been found to be a complex mixture of a variety of organic compounds and inorganic ions. The material was neutral in character and free organic acids were found only to the extent of less than 0·5 per cent. On steam distillation it yielded an essential oil (1·5 per cent) which was conveniently segregated into hexane soluble (9-11 per cent), ethyl acetate soluble (32-35 per cent) and ethyl acetate insoluble (54-59 per cent) portions. Hexane and ethyl acetate soluble fractions were found to be complex blend of steroidal ketones, alcohols and aliphatic triols. Many of these alcohols occurred as esters of ferulic acid. A number of steroids have been isolated and characterised (Patil *et al.*, 1971).

The structure elucidation of steroidal constituents *viz.* Z-guggulsterone, E.-guggulsterone, guggulsterol I, II and III have been established. Partial synthesis of guggulsterol II from diosgenin has also been reported. In addition, diterpenoid constituents cembrene A and mubulol were isolated and their structures elucidated. Some fatty tetrols were also isolated (Patil, 1972; Patil *et al.*, 1972).

**Pharmacological and clinical studies :** The oleoresin portion of the plant was found to be a highly potent anti-inflammatory agent, as compared to hydrocortisone and butazolidin against Brownlee's formaldehyde-induced arthritis in albino rats (Gujral *et al.*, 1960).

The active oleoresin fraction of gum guggul was further sub-fractionated into acidic, nonacidic and solid fractions. The anti-arthritic and anti-inflammatory activities of these fractions were studied using a number of methods, in albino rats. The oleoresin fraction possessed significant anti-arthritic and anti-inflammatory activities, the minimum effective dose being 12·5 mg./100 g. body weight. Only the acidic fraction showed significant activity while the nonacid and solid fractions were inactive. The activity of the acid fraction was found to be present even in the adrenalectomised animals (Santhakumari *et al.*, 1964).

The crude aqueous extract of the oleo-gum-resin was found to suppress acute rat-paw oedema induced by carrageenin. It had also a suppressive action against the granuloma pouch test. In adjuvant arthritis, the extract suppressed the secondary lesions very effectively without having any significant action on the primary phase. Side effects such as gastric ulceration, loss of weight and mortality were negligible in animals treated with the extract as compared to those treated with betamethasone (Satyavati *et al.*, 1969*a*).

A steroidal compound isolated from the petroleum ether extract of the plant, possessed significant anti-inflammatory activity on rat-paw oedma produced by carrageenin. The activity was dose-dependant and much more potent than that of the resin

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fraction. The steroidal fraction had a significant effect on the primary as well as the secondary inflammation induced by Freund's adjuvant, the activity being less than that of hydrocortisone acetate in primary inflammation but it was more effective than hydrocortisone in reducing the severity of secondary lesions. The mechanism of action could be attributed to suppression of the delayed hypersensitivity reaction produced by adjuvant. The anti-phlogistic effect of steroidal fraction was comparable to that of hydrocortisone acetate and was about three times more potent than the resin fraction of the drug (Arora *et al.*, 1971, 1972).

Crude *guggulu* was reported to possess highly encouraging hypolipaemic activity in rabbits (Satyavati, 1966). Hypercholesterolemia was induced in adult male rabbits by feeding (*i*) hydrogenated ground nut oil as well as (*ii*) a combination of crystalline cholesterol and hydrogenated ground nut oil. The effect of the drug was studied on both induction and regression of hypercholesterolemia. The oleo-gum-resin of *Commiphora mukul* was found not only to lower the serum cholesterol in hypercholesterolemic rabbits but also to protect the animals against hypercholesterolemia induced by hydrogenated vegetable oil and cholesterol as also against cholesterol-induced atherosclerosis (at the stage of fatty streek). The drug was also found to reduce the body weight of the hydrogenated ground nut oil-treated rabbits. Anion exchange property detected by means of chloride retention and bile acid sequestrating activity in the oleoresin fraction of *Commiphora mukul* was suggested as a possible mechanism for its hypocholesterolemic activity (Satyavati, 1966; Satyavati, *et al.*, 1969*b*).

Further studies on alimentary hyperlipaemia induced in rabbits by feeding cholesterol in hydrogenated ground nut oil showed that this hyperlipaemia was associated with parallel increase in the coagulability of blood as assessed by estimation of serum turbidity, coagulation time and prothrombin time. Crude *guggulu* as well as its two fractions (alcohol soluble and alcochol-insoluble) were found to cause a significant fall in serum cholesterol and serum turbidity with a concomitant increase in the coagulation time and prothrombin time. The alcohol-insoluble fraction was slightly more potent in this respect than the alcohol-soluble fraction as well as crude *guggulu* (Sastri, 1967; Tripathi *et al.*, 1968).

Studies were conducted on the petroleum ether fraction A (petrol-soluble), B (alkali washed neutral portion) and C (petrol-insoluble) in healthy 8-week old male white leg horn chicks in which hypercholesterolemia was induced by atherogenic diet fed for 2-3 weeks. Experiments were also conducted to see the effect of these fractions on the prevention of hypercholesterolemia when given alongwith the atherogenic diet. All the fractions were found to lower the serum cholesterol, fraction A being the most potent and fraction B being the least potent in this respect. None of three the fractions, however, was found to prevent the induction of hypercholesterolemia in the chicks (Mehta *et al.*, 1968; Mehta and Malhotra 1970).

Further studies on the alcoholic extract of *C. mukul* and two pure fractions (a terpenoid and a steroid) isolated from the petroleum ether extract showed that the steroid fraction was highly potent as a hypolipaemic agent, lowering the serum cholesterol

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(by 69·3 per cent) as well as the C/P ratio. The alcoholic extract could lower the cholesterol by 59·2 per cent whereas the terpenoid lowered it by 54·3 per cent (Malhotra *et al.*, 1970).

The alcoholic extract of *C. mukul*, when administered orally to Indian domestic pigs kept on standard atherogenic diet for 6 months, was found to reduce significantly the total serum cholesterol. The drug also reduced effectively the serum beta-lipoprotein fraction and significantly altered the lipoprotein ratio (Khanna *et al.*, 1969).

In further experiments conducted on rats kept on atherogenic diet, the steroidal compound isolated from fraction A of petroleum ether extract of *C. mukul*, was found to reduce the lipid content (*viz.* total lipids, cholesterol, triglycerides and phospholipids) of both hepatic and aortic tissues. This reduction was found to occur to a greater extent in the hepatic tissue than in the aortic. The response was also found to be dose-related, maximum effect being noted in the group given 10 mg./kg. of the steroid. No significant changes in the body weight were noted in any group of animals (Malhotra and Ahuja, 1972).

Preliminary studies carried out on monkeys fed on cholesterol diet indicated that fraction A of the petroleum ether extract of *C. mukul* could effectively lower serum total lipids, cholesterol, phospholipids and triglycerides. The hypolipaemic activity of fraction A of *C. mukul* in the monkeys were noted to be comparable to that of Atromid-S (Das *et al.*, 1973).

In another study, it was found that the alcoholic extract of *C. mukul*, when administered orally (25-50 mg./kg.), reduced the serum cholesterol level in normal and hyperlipaemic rats and rabbits. On further studies, it was found that a resin fraction, a pure steroid and fraction F isolated from the crude extract showed hypocholesterolemic effect in normal and triton-induced hyperlipaemic rats (Kapoor and Nityanand, 1971; Nityanand and Kapoor, 1971).

The alcoholic extract of *C. mukul* also decreased blood cholesterol in normal and hyperlipaemic rats and rabbits. The activity was found to be present in several fractions and not localised in any one fraction. However, an insoluble residue fraction with no such activity has been obtained which was toxic. Another fraction, comprising fatty trioles also did not show any lowering of cholesterol in triton injected rats. The effect of these fractions on biosynthesis of cholesterol measured by acetate-1-$C^{14}$ incorporation is also being studied in order to find out the mechanism of cholesterol lowering (Nityanand *et al.*, 1973).

Preliminary clinical studies were carried out on 22 patients of hypercholesterolemia associated with obesity, ischaemic heart disease, hypertension, diabetes *etc.* Crude *guggulu* was administered orally in a dose of 6·12 g. in 3 divided doses for 15 days to one month. A fall in the total serum cholesterol and serum lipid-phosphorus was noted in all the cases treated with *guggulu*. The body weight also revealed a significant decline in 10 patients of obesity (Satyavati, 1966; Dwarakanath and Satyavati, 1970).

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Further studies in 12 cases of hyperlipaemia (9 associated with obesity, two cases of ischaemic heart disease and one case of cerebral thrombosis) showed that oral administration of crude *guggulu* could effectively lower the serum turbidity and also prolong the coagulation time in all the 12 cases (Sastri, 1967; Tripathi *et al.*, 1968).

Clinical efficacy of *gum guggulu* (Fraction A) as a hypolipideamic agent was evaluated in comparison with ethyl-p-chlorophenoxy isobutyrate and Ciba-13437-Su. Forty four patients, classified according to Fredrickson's classification were administered these drugs, the selection of cases for each drug being made at random. Fraction A of *gum guggulu* was administered in a dose of 1·0 g. in two divided doses daily. The duration of treatment varied from six to thirty-four weeks. Statistical analysis revealed that fraction A lowered significantly the serum levels of all the lipid fractions (serum total lipids, triglycerides, cholesterol, phospholipids and beta-lipo protein). The lowering of serum triglycerides was found most encouraging in case of gum *guggulu* in comparison to all the drugs known so far. The side effects observed were hiccough in one patient, diarrhoea in three patients and restlessness and apprehension in one patient (Malhotra and Ahuja, 1971).

In a long term clinical study, 41 cases of hyperlipoproteinaemia were followed up after therapy for 75 weeks with fraction A of *guggulu* 1·5 g./day. Ten cases were treated with clofibrate 2·0 g./day for a mean period of 75 weeks. During treatment with fraction A the reduction in serum cholesterol (26·2 per cent) and triglycerides (36·5 per cent) was found to be statistically significant for the entire duration of treatment, as also with clofibrate by which the serum cholesterol and triglycerides were reduced by 31·5 per cent and 33·3 per cent respectively. Fraction A also resolved xanthomatosis in all the 3 cases treated with it, within 30 weeks of treatment. Neither fraction A nor clofibrate was found to reduce the body weight to any significant extent. Except mild diarrhoea in 5 cases, no other side effects were observed with this fraction 'A'.

To elucidate the effect of fraction A on cholesterol metabolism, kinetic studies with 4-$C^{14}$ cholesterol were carried out separately in two series. In the first, the effect of the drug was investigated without attaining isotopic equilibrium, whereas in the second, the studies were done after attaining isotopic steady state (*i.e.* after 40 days in the rats and about 5 weeks in human studies).

From the data of this experimental study in rats it could be interpreted that fraction A enhanced the rate of excretion of cholesterol considerably and also reduced the input/synthesis of cholesterol. The cholesterol pool size also decreased after administration of fraction A. Similarly, clofibrate inhibited the rate of input/synthesis of cholesterol and increased its rate or excretion to a significant extent. In human studies also fraction A of *guggulu* reduced the serum cholesterol levels and the pool size by causing (i) a significant increase in the rate of removal/excretion of cholesterol from the body, and (*ii*) causing mobilization of cholesterol from tissues (as evident clinically by resolution of xanthomatosis).

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Faecal sterol studies in 12 cases of hyperlipoproteinaemia indicated that both fraction A of guggulu as well as clofibrate enhanced the faecal excretion of sterols by 59 per cent and 49·3 per cent respectively.

This long term study indicated that the hypolipidaemic effect of fraction A of *guggulu* could be attributed to : (*a*) increase in the rate of removal/excretion of cholesterol, via the gut (*b*) decrease in the input/synthesis of cholesterol, and (*c*) mobilization of cholesterol from tissues (Malhotra, 1973).

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## CONVOLVULUS (Convolvulaceae)

*C. PLURICAULIS* Chois.

Punj. — Porprang, dodak

**Habitat :** Occurs in plains of northern India and Bihar.

**Chemistry :** An alkaloid sankhapushpine, m.p. 162-164° has been isolated in pure crystalline state from *C. pluricaulis*. Its empirical formula was found to be $C_{17}H_{23}NO_3$. The fresh plant also contained an essential oil whose physical and chemical constants have been determined (Basu and Dandiya, 1948).

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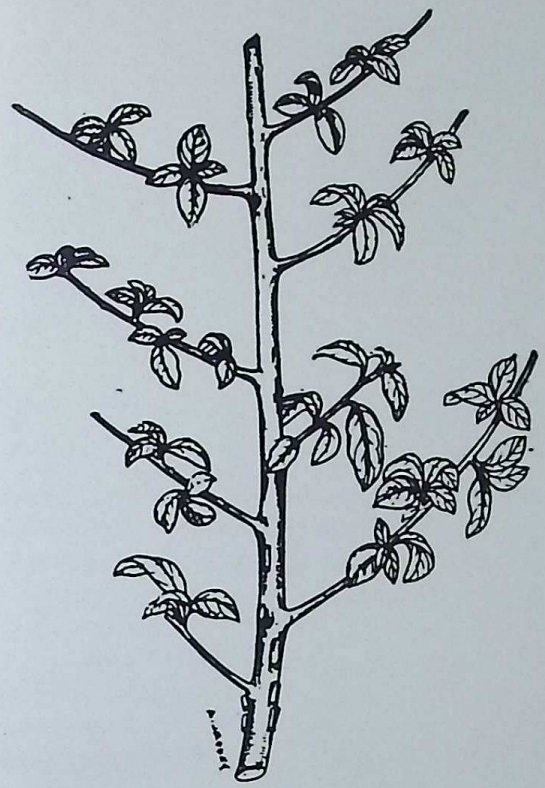

*Commiphora mukul*

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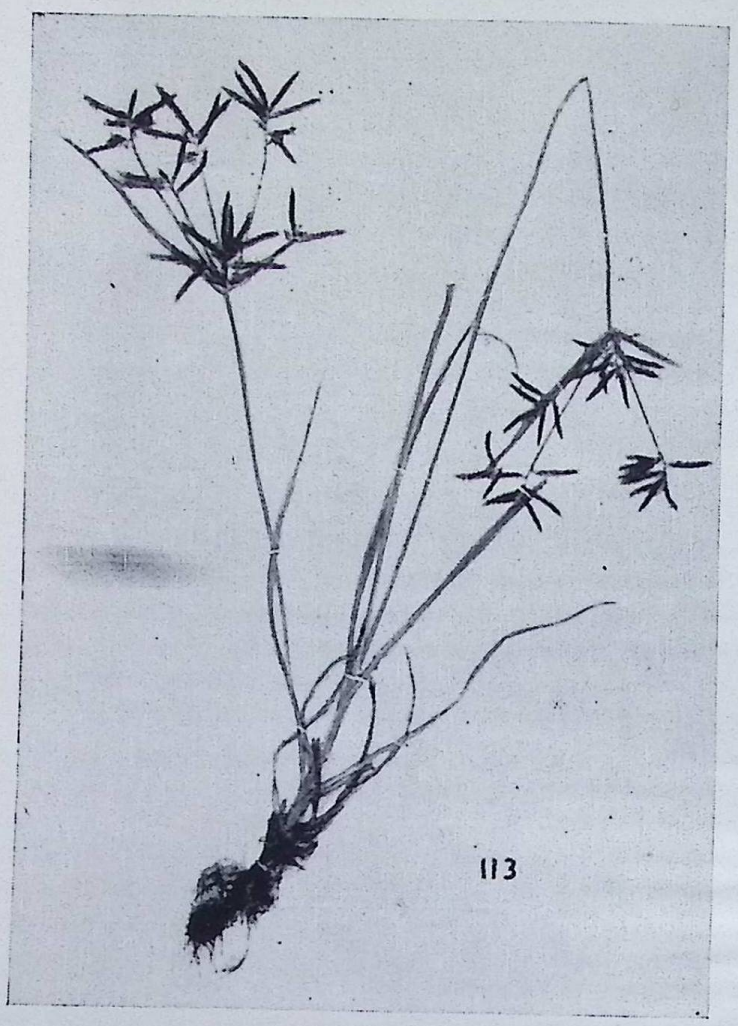


*Convolvulus pluricaulis*

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**Pharmacological and clinical studies :** The alcoholic extract of the whole plant depressed the amphibian and mammalian myocardium. The negative inotropic action was not a sustained one. The extract had a spasmolytic activity on the smooth muscles *viz.* isolated rabbit ileum, isolated rat uterus and intact intestine of dog. The dog's tracheal muscle behaved differently and exhibited a potentiation of acetylcholine response (Barar and Sharma, 1965).

The extract reduced the spontaneous motor activity of mice, the reduction being more marked in amphetamine-treated hyperactive mice. The extract also exhibited potentiation of pentobarbitone hypnosis in mice and morphine analgesia in albino rats. The extract caused a reduction in the fighting response of mice and abolished conditioned avoidance response without affecting the escape response. The electrically induced convulsive seizures in rats and tremorine-induced tremors in mice were antagonized by the extract (Sharma *et al.*, 1965).

The expressed juice of the plant caused a persistent fall in the arterial blood pressure of anaesthetized dogs. In larger doses it produced transient inhibitory effect on both force and rate of contraction of the heart.

The water soluble portion of the total alcoholic extract caused an initial rise followed by a persistent fall in blood pressure of anaesthetized dog. It also increased the rate and force of contraction of the heart. Clinical studies were conducted on 25 cases of arterial hypertension with the decoction of the drug. A gradual fall in blood pressure along with relief in the symptoms was observed (Chaturvedi *et al.*, 1966).

The hypotensive action and potentiation of barbiturate hypnosis with the water soluble alcoholic extractive of different parts of the plant revealed that maximum activity was in the leaves and flowers as compared to the roots and stem (Mudgal *et al.*, 1972).

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## CORCHORUS (Tiliaceae)

*C. ACUTANGULUS* Lam. (Syn. *Corchorus aestuans* Linn.)

Ben. — Titapat

**Habitat :** Found throughout hotter parts of India.

**Parts used :** Seeds.

**Ayurvedic description**

Sanskrit : *Chanchu*

Synonyms : *Chanchukee, chincha, deerghapatra, satiktaka*

Properties : *Rasa* — *Madhura, kashaaya*
*Guna* — *Guru, snigdha, pichchila, sara*
*Veerya* — *Sheeta*
*Vipaaka* — *Madhura*

Actions/Uses : *Snehana, vrishya, graahi, ruchya, mootrala, vranaropani, dhaatupushtikara, jantughna, raktapittahara.*

**Medicinal properties and uses :** Seeds are used as stomachic and in pneumonia (Chopra *et al.*, 1956).

*C. CAPSULARIS* Linn.

Ben. — Tita-pat
Eng. — Jute
Guj. — Chunchdo
Hind. — Pat, singhin
Mar. — Kurru chantz
Tam. — Pirattaikeerai
Tel. — Parinta

**Habitat :** Indigenous to many parts of India, a country-weed in Ceylon. Extensively cultivated in eastern Bengal.

**Parts used :** Leaves and seeds.

**Medicinal properties and uses :** Leaves are demulcent, bitter tonic, stomachic, laxative, carminative, refrigerant and diuretic. Seeds are bitter and purgative (Nadkarni, 1954).

*C. OLITORIUS* Linn.

Ben. — Nalitapat, lalitapat
Hind. — Koshta
Mar. — Tankla
Tam. — Peratti
Tel. — Parintakura

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**Habitat :** Grows wild in many parts of India. It is the predominant species grown in the districts of Hooghly, 24 Parganas and Nadia in West Bengal.

**Parts used :** Leaves and seeds.

**Medicinal properties and uses :** Leaves are demulcent, tonic, diuretic, useful in chronic cystitis, gonorrhoea and dysuria. Infusion of leaves is tonic and febrifuge. Seeds are purgative. Fruit is rich in vitamin C (Chopra *et al.*, 1956; Nadkarni, 1954).

*C. TRILOCULARIS* Linn.

Guj. — Kadvichhunchhdi Mar. — Kaduchhunch
Hind. — Kadukosta

**Habitat :** Found in Bihar, Deccan, Karnataka, Madras, Bombay, Gujarat, Kutch, Sind and Baluchistan.

**Parts used :** Seeds and mucilage.

**Medicinal properties and uses :** Seeds are used in fever and obstruction in the abdominal viscera. Mucilage is demulcent (Chopra *et al.*, 1956).

**Chemistry :** Quercetin, m.p. 300-305° has been isolated from the ethanolic extract of the fresh plant *C. acutangulus* (Sharma *et al.*, 1963).

The seeds of *C. acutangulus* contained numerous cardiac glycosides of the cardenolide type. These included monosides and polar glycosides. Two of the monosides have been characterised as helveticoside and corchoroside A. This was the first time that digitoxose-containing glycosides were reported to be present in *Corchorus* species (Rao and Rao, 1968).

Two polar glycosides were isolated from the seeds of *C. acutangulus* and identified as erysimoside and olitoriside. Erysimoside was not previously reported to occur in *Corchorus* species. Erysimoside had m.p. 178-182°; $C_{35}H_{52}O_{14}$ while olitoriside had m.p. 205-208°, $C_{35}H_{52}O_{14}$. Their structures have been determined (Rao and Rao, 1969).

Seeds of *C. capsularis* were also examined. On autofermentation followed by extraction with methanol, five crystalline monosides were obtained of which two were identified as corchoroside A and helveticoside. Of the other three glycosides, two gave positive Keller-Killiani reaction. The third was found to be a rhamnoside. On direct extraction with methanol and after fractionation and partition chromatography of the methanolic extract of the seeds, two biosides and a trioside were obtained. The biosides were characterised as olitoriside and erysimoside. The trioside which was

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new, was shown to be made of strophanthidin, boivinose and two glucose units (Rao and Rao 1970).

The oligosaccharide components of the seeds of *C. capsularis* and *C. acutangulus* were isolated and identified as sucrose, raffinose, stachynose and verbascose (Rao *et al.*, 1970).

The occurrence of erysimoside along with a new polar glycoside has been reported from *C. capsularis*. The chloroform-butanol (1 : 3) eluates yielded two crystalline polar glycosides A and B. Similar partition chromatography of the chloroform extract residue gave glycoside B and a new polar glycoside C. Glycoside A (0·11 per cent) had m.p. 178-182°; $C_{35}H_{52}O_{14}$. Glycoside B (0·152 per cent) had m.p. 205-8°, $C_{35}H_{52}O_{14}$ identified as olitorisde. Glycoside C had m.p. 200-210/218-225° (Rao and Rao, 1971).

Corchoroside B had the empirical formula $C_{29}H_{42}O_8$ and was found to be a L-rhamnoside of canarigenin, most probably the α, L-rhamnopyranoside (Rao *et al.*, 1971).

From the seeds of *C. olitorius* besides the earlier reported biosides, erysimoside, a new cardenolide glycoside was isolated, which was found to be trioside of strophanthidin. By acid, enzyme and per-iodate degradation studies, it was found to have the same structure as the polar glycoside of *C. capsularis* (Rao *et al.*, 1972).

The seeds of *C. trilocularis* subjected to autofermentation, yielded two crystalline glycosides and two genins. The glycosides were found to be new cardenolides. The major glycoside was named trilocularin and the minor one was found to be identical with corchoroside B. Trilocularin was shown to be β-D-boivanoside of canarigenin from chemical and spectral evidence. Two genins were identified as 3, 5-dianhydroperipiogenin and canarigenin and they might be artifacts (Rao and Rao 1972).

The alcoholic extract of *C. fascicularis* after concentration under reduced pressure, deposited a yellow coloured crystalline substance, with m.p. 162-163°. The compound gave positive test for glycosides. On hydrolysis it yielded glucose (Tariq *et al.*, 1972).

**Pharmacology :** The above mentioned glycoside of *C. fascicularis* was found to be devoid of any effect of its own on the smooth muscle of guineapig ileum but produced spasmolytic effect against acetylcholine, histamine and bradykinin. Direct action of the drug was observed on rabbit intestine. Slight cardiac depressant effect was found on isolated amphibian heart preparation (Tariq *et al.*, 1972).

The alcoholic extract of the entire plant *C. aestuans* was found to have anti-cancer activity against human epidermal carcinoma of the nasopharynx in tissue culture (Bhukuni *et al.*, 1969).

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## CORDIA (Boraginaceae)

*C. MYXA* Linn. (Syn. *C. dichotama* Forst. F.).

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Buhul | Tam. | — | Naruvili |
| Hind. | — | Lasora | Tel. | — | Chinna nakkeru |
| Mar. | — | Gondan | | | |

**Habitat :** Fairly common in south India, wild and often planted.

**Parts used :** Fruit, bark, kernels and leaves.

**Medicinal properties and uses :** Fruit is an astringent, anthelmintic, diuretic, demulcent and expectorant and is also used in affections of urinary passages, diseases of lungs and spleen. Juice of bark is given in gripes. Decoction of bark is used in dyspepsia

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and fevers. Kernels are remedy for ring worm and and leaves are applied to ulcers and also in headache. The whole plant is used is snake bite (Chopra *et al.*, 1956).

**Chemistry*** : The fatty acid composition of the fixed oil from the seeds of *C. myxa* has been analysed. It also contained β-sitosterol which was confirmed by the formation of its acetate, m.p. 126-127°, benzoate, m.p. 144-145° and digitomide, m.p. 221° (Tiwari *et al.*, 1967).

**Reference**

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## COSTUS (Scitaminaceae)

*C. SPECIOSUS* Sm.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Keu | Mal. | — | Channak-koova |
| Hind. | — | Keu, kemuka | Mar. | — | Penva |
| Kan. | — | Pushkaramoola, changalkoshta | Tam. | — | Kottam, koshtam |
| | | | Tel. | — | Kashmeeramu |

**Habitat :** An elegant climbing plant found abundantly in Bengal and Kashmir. It also grows wild in Uttar Pradesh.

**Parts used :** Root and tuber.

**Ayurvedic description**

Sanskrit : *Kemuka*

Synonyms : *Kushta, ruk, pakala, kaashmeeraja, vashya*

Properties : *Rasa* — *Katu*
*Guna* — *Laghu*
*Veerya* — *Ushna*
*Vipaaka* — *Katu*

Actions/Uses : *Kaantikara, shukrala, vaataraktaghna, vishahara, kandooghna, kantharo-gaghna, kushtahara, visarpahara, vishaghna, kaasaghna, shwaasaghna, hikkaashamani, jwaraghna.*

**Medicinal properties and uses :** Root is bitter, astringent, stimulant, digestive, anthelmintic, depurative and aphrodisiac. It is useful in catarrhal fevers, cough, dyspepsia,

*No report available on other aspects.

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worms, skin diseases, and snake-bites. Tuber is cooked and made into a syrup or preserve which is very wholesome (Nadkarni, 1954).

**Pharmacognosy :** In many parts of northern India, particularly in U.P., *Costus speciosus* is used as an adulterant of the plant *Gloriosa superba*. The macro and microscopic characters of the rhizome and root of *C. speciosus* have, therefore, been compared with those of *Gloriosa superba* (Prasad *et al.*, 1969). The salient features are given in the Table.

**Table.**

| *G. superba* | *C. speciosus* |
|---|---|
| *Rhizome* | |
| Rhizomes are cylindrical or slightly flattened with bitter taste | Rhizomes are tuberous and insipid |
| Fibres absent | Fibres present |
| Vascular bundles are collateral with slight extensions of phloem on both sides of xylem | Vascular bundles almost surrounded by xylem (Amphicrebal) |
| Starch grains show concentric striations and measure 11 to 38 μ in diameter | Starch grains do not show striations and measure 6 to 16 μ in diameter |
| *Roots* | |
| Cork cambium arises in the first layers of cortex and forms three layers of cork cells | Cork cambium arises in the third layer of cortex and forms 3 to 5 layers of cork cells |
| During development cortical parenchyma gets disintegrated and forms air-spaces | No such disintegration occurs |
| Central portion of the wood after lignification becomes delignified to a large extent | The delignification is only small |

**Chemistry :** Tigogenin and diosgenin in the free state were isolated from the petroleum ether extract of dried rhizomes of *C. speciosus*. The chloroform extract of the defatted rhizomes yielded a mixture of five saponins as revealed by TLC from which only one saponin, glucoside of β-sitosterol, $C_{35}H_{60}O_6$, m.p. 289-290°, could be isolated in pure crystalline form. The saponin mixture on acid hydrolysis exhibited the presence of

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4 sapogenins in different proportions on TLC plate, from which only β-sitosterol and diosgenin could be isolated. The other sapogenins present in traces could not be separated. The alcoholic extract of the dried rhizomes on acid hydrolysis yielded 3·86 per cent total sapogenin which, on further crystallisation and chromatography, yielded about 2·12 per cent pure diosgenin. This diosgenin content compared favourably with that of *Dioscorea prazeri* (Pandey and Dasgupta, 1970).

Two saponins were isolated from the chloroform extract of the dried powdered rhizomes of *C. speciosus*. Saponin A isolated as granules with m.p. 289-290°, on acid hydrolysis gave glucose and β-sitosterol and saponin B also as granules having m.p. 305-307°, on acid hydrolysis yielded diosgenin, glucose and rhamnose.

The alcoholic extract of the fresh moist rhizomes yielded saponin C (granules) m.p. 232-233°, which on crystallisation from 80 per cent alcohol yielded fine needles of saponin D, m.p. 301-302°. Both saponins C and D, on hydrolysis, yielded diosgenin, glucose and rhamnose.

The saponins A, B and C, differed from each other in the relative proportions of glucose and rhamnose, as revealed by their paper chromatographic studies. Glucose dominated over rhamnose in the three saponins (Dasgupta and Pandey, 1970; Pandey *et al.*, 1972).

**Pharmacology :** The saponins of the plant were found to have significant anti-inflammatory and anti-arthritic activity against acute pedal inflammation induced by carrageenin (1 per cent) and formalin (1 per cent) in albino rats. It also significantly suppressed the inflammatory exudate formation in croton oil granuloma pouch and granulation tissue formation by cotton pellet implantation in albino rats. The results were compared with betamethazone and found to be qualitatively similar though less effective but with the advantage of not producing gastric lesions common with corticosteroids (Parikh *et al.*, 1970 Bhattacharya *et al.*, 1971).

The total saponin mixture was found to have significant anti-inflammatory activity. The results compared quantitatively with those obtained with betamethazone (Pandey *et al.*, 1972; Singh *et al.*, 1972).

The saponins significantly increased the weight of uterus in spayed albino rats, the results being comparable to those produced by stilboesterol. The saponins produced proliferative changes in the uterus and vagina which were similar to those produced by stilboesterol (Pandey *et al.*, 1972; Singh *et al.*, 1972).

A comparative study of the uterine activity of *Costus speciosus* and *Gloriosa superba* was conducted. The fresh juice of both the plants had a stimulant action on isolated uterine preparations of guineapig, rabbit and human beings and on rabbit and dog's uterus *in situ*. On isolated rat uterus, however, it was found that *Costus speciosus*

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had a stimulant action whereas *Gloriosa superba* had a papaverine-like action. *C. speciosus* was found to be 2·5 times more potent than *G. superba* as an ecbolic agent (Tewari *et al.*, 1967).

The chloroform extract (containing saponins) was found to be a most potent ecbolic agent exerting its action directly on the uterine muscle. The effect was found on isolated estrinized rat's uterus (Tewari *et al.*, 1971).

Crops of five saponins of the chloroform extract were studied individually on estrinized rat uterus. The mother residue, and crop B seemed to be inert, crop A very mild relaxant, crop C very mild stimulant and crop D, E and F strong agents. Detailed study of crop D in rat, guineapig, rabbit and dog and also human uterus, in different hormonal conditions *viz.* diestrus, metestrus and estrus phases, oestrogen and progesterone treated uterus and puerperal stage, as well as different stages of pregnancy and also *in situ* preparations, revealed that it had a strong direct stimulant action on the uterus. A relaxant effect was observed on the human fallopian tube. Isolated human uterus, pregnant uteri and uteri *in situ* of guineapig, rabbit and dog seemed to be highly sensitive to its stimulant action (Tewari *et al.*, 1972).

Studies were carried out on ovariectomised albino rats in which the plant extract was injected on five consecutive days and compared with those receiving only oestrogen for five days and another group receiving oestrogen for five days followed by the plant extract for another five days. The extract-treated rats showed marked proliferation and cornification of vaginal epithelium comparable with that found in the estrous phase in ovariectomised rats. In the third group which received both oestrogen and the plant extract, cornification of vaginal epithelium was absent and there was little proliferation (Sanyal and Singh, 1971).

The alkaloids isolated from the plant possessed anti-cholinesterase activity both *in vitro* and *in vivo* which confirmed the earlier observations of potentiation of acetylcholine responses on frog rectus muscle and dog blood pressure. The alkaloids, like physostigmine, were almost equally effective against true and pseudo-cholinesterase, but were much weaker than physostigmine. The use of the plant in eye disease and as a depurative might be due to its anticholinesterase activity (Bhattacharya *et al.*, 1972).

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## COUROUPITA (Lecythidaceae)

*C. GUIANENSIS* Aubl.

Eng. — Cannon-ball tree

**Habitat :** A tree, distributed in south America and West Indies, frequently found in botanical gardens in India.

**Parts used :** Bark and Leaves.

**Medicinal properties and uses :** Leaves are used in skin diseases. (Wealth of India, 1950).

**Chemistry* :** The ether extract of the bark contained α-amyrin. m.p. 186-87°, β-amyrin, m.p. 197°, β-sitosterol, m.p. 136-37° and an unknown plant alcohol, m.p. 101-103° (Row *et al.*, 1966).

*No report available on other aspects.

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## CRATAEVA (Capparidaceae)

*C. NURVALA* Buch. Ham. (Syn. *C. religiosa* Hook and Forest, *C. roxburghii* Br.)

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Tikoshak | Kon. | — | Narvala |
| Eng. | — | Three leaved caper | Mal. | — | Nirvala |
| Guj. | — | Vayavarna | Mar. | — | Vayavarna |
| Kan. | — | Narumbele, varuna | Tam. | — | Maralingam |
| Hind. and Punj. | — | Barna | Tel. | — | Uskia |

**Habitat :** Usually cultivated in the vicinity of temples in central India, Bengal and Assam, found near streams in Malabar and Karnataka.

**Parts used :** Bark, leaves and root-bark.

**Ayurvedic description**

Sanskrit : *Varuna*

Synonyms : *Ashmaghna, kumaaraka, sethuvriksha, ashmareeghna, paadapa, triparnee, bhramarapriya, bilwapatra, vrittaphala, barhapushpa, kashaayaka*

Properties : *Rasa* — *Kashaaya, madhura, tikta,*
*Guna* — *Laghu, rooksha (snigdha ?)*
*Veerya* — *Ushna*
*Vipaaka* — *Katu*

Actions/Uses : *Deepanee, anulomanee, bhedanee, ashmareebhedana, raktotklishta (lepana), mootrala, mootrakritchrahara, vidradhighna, gulmaghna, vaataraktahara, shothaghna.*

**Medicinal properties and uses :** Leaves are stomachic and tonic; root and bark are laxative and lithotriptic, and the root is also alterative. Root and bark promote appetite and increase biliary secretion; fresh leaves are externally rubefacient and internally febrifuge and tonic (Nadkarni, 1954).

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**Pharmacognosy :** The mature bark of *C. nurvala* has thin cork, one or two outer layers of which get often sclerosed. A very wide zone of secondary pholem possessing concentric strands of ceratenchyma, alternating with strands of stone-cells is present. Starch grains are simple and compound and crystals of calcium oxalate are found in most of the parenchyma cells (Prasad *et al.*, 1966*b*). The macro and microscopic characters of the genuine sample of *C. nurvala* leaf have been reported. The leaves are alternate, petiolate, exstipulate, with fairly large trifoliate leaflets. Transection of the petiole shows an outer layer of epidermis, surrounded by a thick cuticle. This is followed by collenchyma. The stellar ring has a number of vascular bundles, which are collateral, open and composed of xylem and phloem traversed by medullary rays. Glands are present in pith cells.

The petiolule has a concavo-convex outline. The lamina shows the structure of the dorsiventral type of leaf. Stomata are of ranunculaceous or cruciferous type, on the lower surface. The structure of the midrib is almost like that of the petiole. Tannin and resin is present in the parenchymatous cells of the petiole and leaf. The palisade ratio and vein-islet number have been determined. The fluorescence analysis, extractive and ash values are also recorded (Mitra and Kapoor, 1971*a*).

A detailed study of the root and root bark has been carried out and distinguishing features of the root and stem bark, have been indicated. The roots are long and show a tetrarch stele. The root bark is thick and rough due to the presence of lenticels and show a wide zone of cork, phellogen and phelloderm. This is followed by pheloem consisting of ceratenchyma in the outer and middle region and sieve tube, companion cells, parenchyma alternating with bands of stone cells and fibres in the inner region. The rhytidome is formed on further maturation. Starch grains and calcium oxalate crystals are present (Mitra and Kapoor, 1971*b*).

**Chemistry :** A purified crystalline product was obtained by successive extraction of air-dried powdered bark of *C. religiosa* with absolute alcohol and petroleum ether mixture. The compound was identified as lupeol (Chakravarti *et al.*, 1959).

Chemical analysis of *C. nurvala* showed the presence of low melting alcohols, β-sitosterol, triterpenoid (lupeol), quarternary bases and traces of a tertiary base. The water soluble portion of the alcoholic extract was found to contain excess of sugar along with traces of quarternary and tertiary bases. The isolation of the quaternary and tertiary bases in pure form was not possible. The sugar portion extracted in impure form showed the presence of sulphur. The quarternary base fraction showed on TLC, the presence of choline and two other basic components. The bases were, however, isolated by treatment with ion exchange resin, but being highly hygroscopic, could not be obtained in pure form. The picrate of one of the bases had m.p. 327-330°. Picrate of the other decomposed with explosion at 327°. The tertiary base was obtained in a resinous form and showed the presence of both sulphur and nitrogen (Dasgupta, 1970).

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**Pharmacological and clinical studies :** The petroleum ether extract and sterols isolated from the stem bark, in a dose of 10 mg./100 g. body weight each, significantly inhibited the acute inflammation induced by carrageenin and histamine in albino rats. In subacute inflammation, both these suppressed the formation of exudate in the granuloma pouch. In formaldehyde-induced arthritis, both inhibited the early and delayed phases of inflammatory changes. In all the tests, however, they were less effective than betamethazone and phenyl butazone. In adjuvant arthritis produced by intradermal injection of Freund's adjuvant, the extract and the sterols had the significant anti-inflammatory activity on the primary and secondary phases. In adrenalectomised rats, they suppressed significantly the carrageenin-induced oedema (Ramjilal *et al.*, 1972).

Clinically, *C. nurvala* (whole plant powder) was found to improve the tone of the urinary bladder in 12 cases of prostatic enlargement post-operatively. This action can be attributed to the cholinergic action of the drug in smooth muscles, including the urinary bladder (Deshpande, 1973).

The drug has been found effective in removing smaller stones from ureters and urinary bladder both experimentally and clinically. The drug has also been found to be useful in early obstructive uropathy and in neurogenic bladder. It has also been used beneficially to control different symptoms produced by various urinary tract infections (Deshpande, 1973).

The water soluble fraction of the air-dried bark was found to have spasmodic action on uteri of albino rat, guineapig, rabbit, dog and human beings and cholinergic action on isolated ileum of rabbit, guineapig, albino rat and dog tracheal muscle preparation. The extract was also found to possess marked nicotinic action besides the muscarinic action. The nicotinic action was seen in isolated frog rectus muscle, dog's blood pressure and frog heart. The spasmodic action of the extract was not blocked by atropine in uterus. Higher doses depressed the smooth muscles and also caused relaxation of dog's small intestine *in situ* (Prasad *et al.*, 1966*a*).

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# CRESSA (Convolvulaceae)

*C. CRETICA* Linn.

| | | | | | |
|---|---|---|---|---|---|
| Hind. | | | Sans. | — | Rudanti |
| and Ben. | — | Rudravanti | Tam. | — | Uppu-sanaga, alukanni |
| Mar. | — | Khardi | Tel. | — | Uppu-sanaga |

**Habitat :** Found throughout India.

**Parts used :** Whole plant and leaf.

**Medicinal properties and uses :** Plant is tonic, aphrodisiac, expectorant and antibilious. Leaves are used as tonic and aphrodisiac (Chopra *et al.*, 1956; Nadkarni, 1954).

**Pharmacognosy :** Studies on *C. cretica* were carried out to find out the exact identity of *Rudanti* which remains undecided. A similarity was observed between the powder of this plant and that of *Evolvulus alsinoides*. But the two plants can be distinguished from each other by a few characteristics which are tabulated below (Satakopan and Karandikar, 1961).

| *E. alsinoides* | *C. cretica* |
|---|---|
| One type of unequally armed trichomes on the stem | Two types of trichomes, one ordinary and the other spindle shaped on the stem |
| Ca-oxalate crystals present alo. ~ the veins of leaves | Ca-oxalate crystals scattered throughout |
| Secretory canals present in the leave. | Secretory canals absent in the leaves |
| Compound starch grains in the root | Simple starch grains in the rhizome |
| Abundant pollen grains | No pollen grains, collection done before flowering |
| Epidermal cell walls sinuous and characteristic bundle ends present in leaves | Not so in this plant leaf |

**Chemistry :** The chemical investigation of the hexane and benzene extracts of the whole plant yielded n-octacosanol, m.p. 82°; β-sitosterol, m.p. 136°, and a close mixture of $C_{26}$, $C_{28}$ and $C_{30}$ straight chain fatty acids of which n-octacosanoic acid ($C_{28}$ acid) was found to occur as major constituent. These acids formed easily methyl ester derivatives with diazomethane (Purushothaman *et al.*, 1972).

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## CRINUM (Amaryllidaceae)

*C. DEFIXUM* (Syn. *C. asiaticum* Linn., *C. latifolium* Linn., *C. bracteatum*, Willd. *C. toxicarium* Roxb., *Amaryllis zeylanicum* Linn.)

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Sukdarshan | Kon. | — | Kirtmari |
| Eng. | — | Poison bulb | Mal. | — | Vishamula |
| Guj. | — | Nagdowan | Mar. | — | Gadani-kanda |
| Hind. | — | Chindar | Tam. | — | Tudaivachi, vishamaangil |
| Kan. | — | Vishamoonguli | Tel. | — | Kesarichettu |

**Habitat :** Grows at swampy river banks throughout India.

**Parts used :** Bulbs and leaves.

**Ayurvedic description**

Sanskrit : *Kandali*

Synonyms : *Saptaachakrakam, kandari, bisakandara, vishnukanda, somavalli, chakraangi, madhuparnika, vatsaadani, machchaka.*

Properties :

| | | |
|---|---|---|
| *Rasa* | — | *Madhura* |
| *Guna* | — | *Laghu* (?) |
| *Veerya* | — | *Ushna* |
| *Vipaaka* | — | *Katu* (?) |

Actions/Uses : *Raktavikaaraghna, shophaghna, vaataraktahara.*

**Medicinal properties and uses :** Bulbs are nauseant, emollient, emetic, diaphoretic, also used for the treatment of burns, whitlow, carbuncle and are toxic to cattle. Leaves and roots are a good substitute for ipecacuanha. The juice of the leaves is used in earache. Bulbs when crushed and roasted are used as rubefacient and in rheumatism (Chopra *et al.*, 1956; Nadkarni, 1954).

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**Chemistry*** : An alkaloid lycorine, m.p. 272-276° has been isolated from the bulbs of *C. defixum*. The identity of the compound was confirmed by its m.p., optical rotation, by a positive gallic acid test for methylene dioxy group and by the preparation of its crystalline diacetate and hydrochloride (Rangaswami and Venkata Rao, 1954).

The alkaloid lycorine has also been isolated from the seeds of *C. defixum* and its identity has been confirmed (Rangaswami and Venkata Rao, 1955*a*).

Lycorine was also obtained from the bulbs of *C. latifolium* in slightly greater percentage (0·07 per cent) than in *C. defixum* (0·053 per cent). The analyses agreed with the formula $C_{16}H_{17}O_4N$ (Rangaswami and Venkata Rao, 1955*b*).

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## CROTALARIA (Papilionaceae)

*C. JUNCEA* Linn. (Syn. *C. bengalensis* Lamk., *C. fenestrata*, Sims.)

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Sonpat, shun | Mal | — | Janapa |
| Eng. | — | Sunn hemp | Mar. | — | Tag |
| Guj. | — | Sun | Tam. | — | Shanabo |
| Hind. | — | Masina, san | Tel. | — | Janamu |
| Kan. | — | Sanabu | | | |

**Habitat :** Grows throughout the plains of India, especially Mysore, Deccan and southern India.

**Parts used :** Leaves, roots and seeds.

*No report available on other aspects.

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**Ayurvedic description**

Sanskrit : *Shana*

Properties : *Rasa* — *Kashaaya*
*Guna* — *rooksha*, *teekshna*, *snigdha* (leaves)
*Veerya* — *Sheeta* (leaves); *ushna* (seeds)
*Vipaaka* — *Katu*

Actions/Uses : *Malapaachana*, *garbhaasrapatana*, *vamanakrit*, *teevraangamardaghna*.

**Medicinal properties and uses :** Leaves are refrigerant, demulcent, emetic, purgative, emmenogogue and abortive. Root is astringent while the seeds are used to purify blood (Nadkarni, 1954; Chopra *et al.*, 1956).

*C. LABURNIFOLIA* Linn.

Hind. — Muna
Tel. — Pedda-galligista

**Habitat :** Occurs in western penninsula, northern Circars, Ceylon and is often cultivated in gardens for its large yellow flowers.

**Parts used :** Whole plant.

**Medicinal properties and uses :** Infusion of the whole plant is used as gargle for sore throat and inflammation of the mouth (Chopra *et al.*, 1956).

*C. MEDICAGINEA* Lamk.

Guj. — Ranmethy
Mar. — Jenjaru
Hind. and Punj. — Gulabi

**Habitat :** Grows wild in south India.

**Parts used :** Seeds.

*C. RETUSA* Linn.

Ben. — Bil-jhunghun
Hind. — Ghunghunian
Mar. — Ghagri
Tam. and Tel. — Potu galli gista

**Habitat :** Grows in south India, in the tropical regions of India from Himalayas to Ceylon and also occasionally cultivated.

**Parts used :** Seeds.

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**Medicinal properties and uses :** Used in scabies and impetigo (Chopra *et al.* 1956; Nadkarni, 1954).

*C. VERRUCOSA* Linn.

| | | | | | |
|---|---|---|---|---|---|
| Ben. and Hind. | — | Jhanjhania | Tam. | — | Vittakillu |
| Mar. | — | Tirat | Tel. | — | Ghalegherinta |

**Habitat :** Grows in south India.

**Parts used :** Leaves.

**Ayurvedic description**

Sanskrit : *Shanapushpi*

Synonyms : *Ghantaarava, shanasamakriti*

Properties : *Rasa* — *Tikta, kashaaya*
*Guna* — *Laghu, rooksha, teekshna*
*Veerya* — *Ushna*
*Vipaaka* — *Katu*

Actions/Uses : *Vamanakari, kantharogavinaashani, hridrogaghna, mukharoganaashini.*

**Medicinal properties and uses :** The juice of leaves is used in scabies and impetigo; considered efficacious in diminishing salivation, when used internally as well as externally (Chopra *et al.*, 1956; Nadkarni, 1954).

**Pharmacognosy :** The structure and development of secretory idioblasts in the leaves of *C. retusa* have been studied. The idioblasts appear as circular to oblong on upper and lower epidermis and arise from protoderm initials without any further division. The presence of a large nucleus at various intermediate stages point towards the secretory nature of the idioblasts. Their presence may be of some toxonomic significance in distinguishing different species. They were also observed in other species like *C. juncea, C. mysorensis, C. paniculata* and *C. striata* but were not so prominent as in *C. retusa* (Krishnamurthy and Kannabiran, 1970).

**Chemistry :** The genus *Crotalaria* is of interest because of the presence of pyrrolizidine alkaloids which are known to have anti-tumour, hypotensive and mutagenic properties. They are quite toxic and affect the liver and hence are known as liver toxins. A series of investigations on Indian *Crotalarias* have led to the isolation and identification of 24 alkaloids from 18 species.

Croalbidine, m.p. 208-209°, $C_{18}H_{29}NO_7$, a new pyrrolizidine alkaloid isolated from *C. albida* has been found to be a diester of croalbinecine (2, 7-dihydroxy-1-hydroxy-

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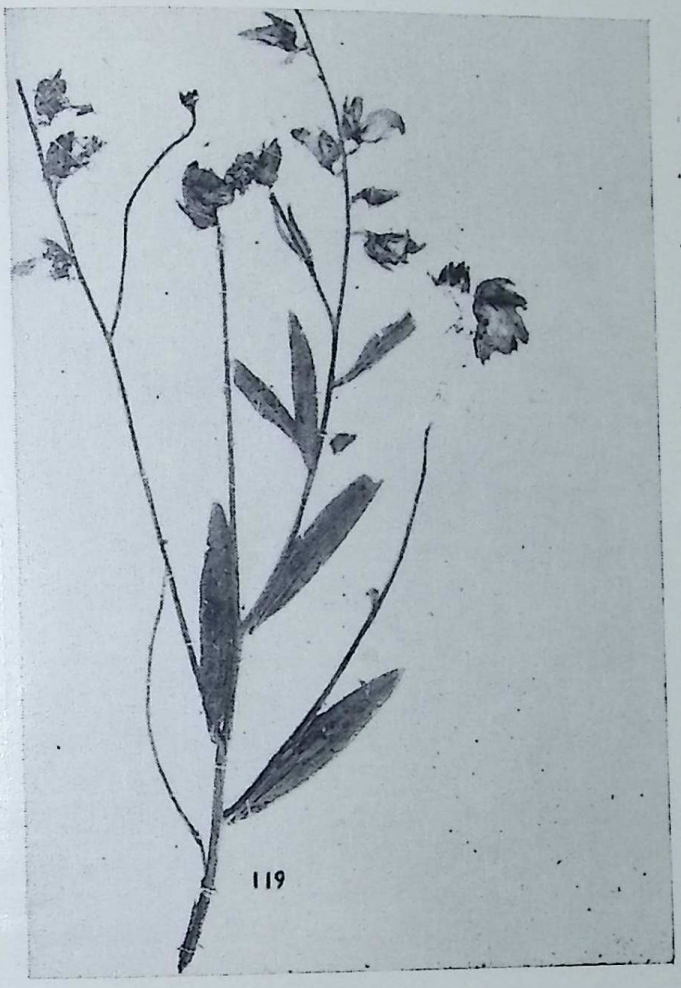


*Crotalaria retusa*

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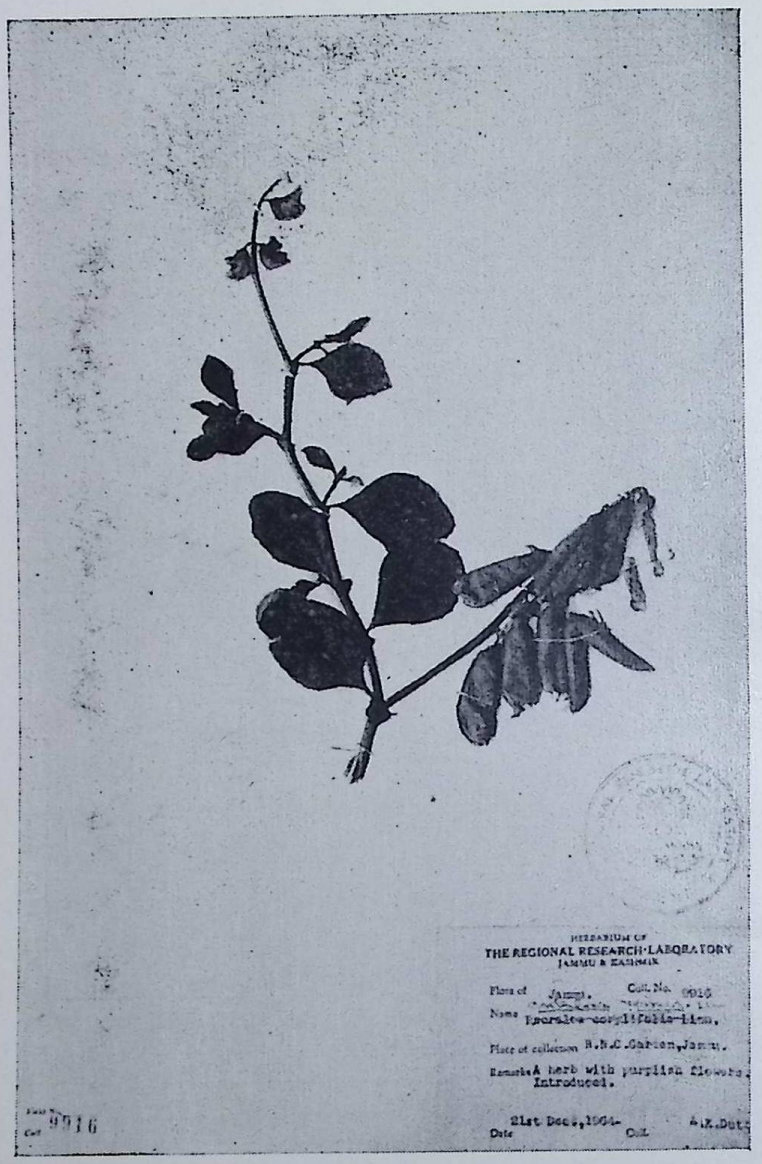


*Crotalaria verrucosa*

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methyl-pyrrolizidine) and trichodesmic acid (Sawhney and Atal, 1973). The main liquid alkaloid obtained from the crude base by distillation at 72-75°/36 mm. had empirical formula $C_8H_{13}N$ which formed picrate, m.p. 210-213° and picrolonate m.p. 172-173°. These characters and its IR and NMR spectra showed that it was identical with 1-methylenepyrrolizidine, isolated from the Australian variety of *C. anagyroides*. A solid base having empirical formula $C_{18}H_{25}NO_5$, m.p. 232-235° (decomp.) was also isolated from the plant. These characters and IR showed that it was identical with senecionine, which was found to occur in *C. juncea* also (Sethi and Atal, 1964).

A new macrocyclic pyrrolizidine alkaloid crobarbatine $C_{15}H_{21}NO_5$, was isolated from the seeds of *C. barbata*. The structure of the base having m.p. 142°, has been derived with the aid of IR, NMR, mass spectra and by chemical means (Puri *et al.*, 1971, 1973). β-sitosterol and integerrimine were isolated from *C. brevifolia* (Sawhney and Atal, 1966).

The seeds of *C. grahamiana* yielded a major alkaloid melting at 196° and was identified as monocrosaline. The minor alkaloid melted at 160-161° (Gandhi *et al.* 1966*a*). This was later found to be an acyl derivative of monocrotaline (Atal *et al.*, 1969).

The alkaloids integerrimine and usarmine were isolated from the seeds of *C. indica*, and identified by mixed melting point, IR and NMR comparison with authentic sample (Sawhney and Atal, 1970*a*).

Seeds of *C. juncea* were examined for their oil content and the characteristics of the oil determined. Mixed fatty acids, separated from the oil, were studied for the content of linoleic acid, linolenic acid and oleic acid by spectrophotometric methods. The fatty acids were identified by reverse phase TLC (Zafar *et al.*, 1972).

Some alkaloids were isolated from *C. laburnifolia* and their properties studied (Ghosh and Emmanuel, 1964). From the seeds of *C. laburnifolia*, the occurrence of flavonoid C-glycosides, orientin, iso-orientin and an O-glycoside of quercetin have been reported. Three major alkaloids have been detected by means of paper chromatography and TLC on silica gel (Subramanian and Nagarajan, 1967*a*).

The major alkaloid of *C. laburnifolia* seed was a cyclic diester of the pyrrolizidine group with senecic acid as the acid part, necine ($C_{18}H_{13}O_3N$) having hydroxy-methyl group in the 1-position and a hydroxyl in the 7-position, the position of the third hydroxyl group remained unsettled (Gandhi *et al.*, 1967). They also noted that there was considerable resemblance between it and anacrosine though data were insufficient to arrive at a definite conclusion.

An improved method for the separation of the crystalline components of the seeds of *C. laburnifolia* has been worked out by soxhlet extraction and fractionation followed by adsorption chromatography. The major component crotalaburnine possessing significant pharmacological activity has been isolated. The recovery of the flavonoid glyco-

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sides was fairly complete. The flowers contained only hyperoside and no flavonoid-glycosides as in the case of seeds (Subramanian and Nagarajan, 1968).

The pyrrolizidine macrocyclic diester alkaloid anacrotine, $C_{18}H_{25}NO_6$, m.p. 191-192°, has been reported in *C. anagyroides*, *C. laburnifolia* and *C. incana*. Isolation of an uncharacterised alkaloid $C_{16}H_{23}NO_5$, m.p. 184-186° (d) was reported from the seeds of *C. laburnifolia* by Emmanuel and Ghosh (1964). Later on, this was named as crotalaburnine without any comments on its structure. Subsequently, Gandhi *et al.*, (1967) also reported the isolation of crotalaburnine $C_{18}H_{25}NO_6$, m.p. 197-199° (d). This was obviously anacrotine, but wrongly named by various authors. By direct comparison of the two alkaloids having identical m.p. and m.m.p., same Rf values etc., it has been confirmed that the two alkaloids are identical (Sawhney and Atal, 1971).

Two alkaloids were obtained from the seeds of *C. lechanaultii*. The first alkaloid had m.p. 195° and was identical with monocrotaline and the other alkaloid had m.p. 136°, $C_{16}H_{23}O_5N$, named crispatine (Suri and Atal, 1967).

The whole plant including roots of *C. medicaginea* yielded necine, $C_9H_{15}NO_2$ as a liquid which gave a hydrobromide melting at 171-73°. The necine was present almost completely as its N-oxide (Gandhi *et al.*, 1966*b*).

From the seeds of *C. medicaginea*, two alkaloids have been isolated and characterised as methyl ethers of supinidine and heliotridine. Their structures were confirmed by means of spectroscopic and chemical evidence (Atal and Sawhney 1969; Sawhney and Atal, 1970*b*).

A new pyrrolizidine alkaloid, nilgirine has been isolated from *C. mucronata*. This alkaloid on hydrolysis gave retronectine and nilgiric acid. The structure of nilgiric acid has been found to be 1-hydroxy-2-methyl-hexa-4-ene-1: 4 dicarboxylic acid. This is the first report of a $C_9$ necic acid occurring in pyrrolizidine diester monocrotaline (Sawhney and Atal, 1972).

The seeds of *C. mysorensis* showed the presence of β-sitosterol and the pyrrolizidine diester monocrotaline (Sawhney and Atal, 1968).

The major alkaloid of the seeds of *C. paniculata* has been isolated in about 1·5 per cent yield and identified as fulvine, which is similar to crotalaburnine in having papaverine-like activity. The seeds also contained β-sitosterol (Subramanian *et al.*, 1968).

The alkaloid monocrotaline originally isolated from *C. sericea* was later found to occur in *C. retusa*. The highest yield of total alkaloid 10-12 per cent was obtained from *C. retusa* of Brazilian origin (Kumari *et al.*, 1967).

The pigments of the seeds of *C. retusa* and *C. striata* were examined. The isolation of isoquercitrin from the seeds of *C. retusa* has been reported. The seeds of *C. retusa* biosynthesize only a flavonol-O-glycoside and no flavonoid-C-glycoside (Subramanian and Nagarajan, 1969).

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Two alkaloids *viz.* trichodesmine, $C_{18}H_{27}NO_6$, m.p. 154-155° and junceine, $C_{18}H_{27}NO_7$, m.p. 188-189° were isolated from *C. rubiginosa* (Atal *et al.*, 1966*a*).

Chrysoeriol-7-rutinoside has been isolated from the seeds of *C. saltiana* (Subramanian and Nagarajan, 1971).

The seeds of *C. semperflorens* were found to contain at least three alkaloids. One of them has been reported as crosemperine $C_{19}H_{29}NO_6$, m.p. 117-118°. This has the structure of a diester of otonecine with incanic acid (Atal *et al.*, 1967).

A new alkaloid crotastriatine, m.p. 1133°, was isolated from the seeds of *C. striata* and its properties described. It is retronecine derivative (Gandhi *et al.*, 1968).

The seeds of *C. verrucosa* have been found to contain β-sitosterol, isovitexin, vitexin and four bases, one of which is identical with crotalaburnine (Subramanian and Nagaranjan, 1967*b*).

Two new pyrrolizidine alkaloids *viz.* isosenkirkine and O-acetylisosenkirkine have been isolated from the seeds of *C. verrucosa*. Their structures were derived on the basis of spectral and chemical evidence. The acid hydrolysis of these macro-cyclic diesters yielded otonecine and an acid, m.p. 137° (Sawhney *et al.*, 1972).

Considerable variation was noted in the alkaloid content among various species of *Crotalaria* examined. The proportion of Noxides to tertiary bases did not follow any fixed pattern but was highly variable. In *C. verrucosa*, seed, pod and leaf did not show the presence of N-oxide alkaloids whereas in *C. semperflorens* and *C. barbata* the percentage of N-oxides was higher than that of the tertiary base (Sharma *et al.*, 1965).

Two alkaloids were isolated from *Crotalaria* species which were diestres of a new amino alcohol. Crotanecine was obtained from *C. madurensis* and *C. agatiflora* whereas anacrotine was obtained from seed of *C. anagyroides* (Atal *et al.*, 1966*b*).

Seeds of six species of *Crotalaria* were examined for their oil content and their various characteristics studied. All the *Crotalaria* species studied in this case showed a definite pattern, the major component being linoleic acid followed by oleic and linolenic acids in decreasing order (Kapur *et al.*, 1968).

Major alkaloids of *C. mucronata* and *C. brevifolia* have been identified as usaramine isolated earlier from *C. usaramoensis* (Sawhney *et al.*, 1967).

The flavonoids of *C. striata*, *C. paniculata* and *C. anagyroides* have been studied. Apigenin and its glycosides were commonly found to occur (Subramanian and Nagarajan, 1970).

Chemical work done on various pyrrolizidine alkaloids from different species of *Crotalaria* has been compiled in a review article (Atal and Sawhney, 1973).

**Pharmacology :** Crotalaburnine, isolated from the seeds of C. *laburnifolia*, was found to have a significant anti-inflammatory activity against carrageenin-induced rat hind

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paw oedema, producing 69 per cent inhibition and also against cotton-pellet granuloma producing 58 per cent inhibition in rats. The formaldehyde arthritis was, however, inhibited by the drug only in the first three days of the experiment (Singh and Ghosh, 1968).

Crotalaburnine was further found to have anti-hyaluronidase activity in rats, its potency being intermediate between phenyl butazone and sodium salicylate. The drug inhibited the oedema even in adrenalectomised animals suggesting that its activity was independent of adrenal cortex (Singh and Ghosh, 1970).

Crotalaburnine was also found to have a papaverine-like action on guinea-pig ileum and rabbit duodenum. In anaesthetized guineapig, it was as potent a bronchial anti-spasmodic as papaverine against acetylcholine-induced spasm both *in vitro* and *in vivo*, but against histamine-induced spasm it was found ineffective. The drug in a dose of 1-2 mg./kg. produced a slight and transient hypotension and casued mild inhibition in the vagal and acetylcholine response on blood pressure. $LD_{50}$ was found to be 83 mg./kg. intravenously in mice (Snehlata and Ghosh, 1968*a*, *b*).

Monocrotaline, isolated from *C. sericea* had a prolonged and pronounced hypotensive effect with a depressant effect on the isolated heart. It exerted a powerful stimulant effect on the smooth musculature especially of ileum and uterus. All these effects of the drug could be abolished by prior atropinization (Garg and Sethi, 1962).

The alcoholic extract of *C. agatiflora* showed marked hypotensive activity in anaesthetized dogs without any effect on heart and exhibited slight spasmolytic and relaxant effects on smooth muscles of different species of animals. $LD_{50}$ was found to be 900 mg./kg. intraperitoneally in rats (Sharma *et al.*, 1967).

Usarmine, isolated from *C. brevifolia* exhibited marked hypotensive effect in anaesthetized dogs. The hypotensive effect appeared to be partly central and partly peripheral due to decreased cardiac output. It produced relaxant effect and exhibited spasmolytic property against known spasmogens in smooth muscles of different animals. This action resembled that of papaverine hydrochloride. $LD_{50}$ of usaramine in mice was 300 mg./kg. intraperitoneally (Singh *et al.*, 1969).

The alcoholic extract of *C. juncea* produced a transient rise in blood pressure in anaesthetized and spinal dogs upto 48 mg./kg. and it did not alter significantly the vasomotor response to acetylcholine, adrenaline, histamine and carotid occlusion. On isolated frog and mammalian hearts, slight positive chronotropic and inotropic effects were noted. The extract showed a slight antidiuretic effect. It also showed fungistatic activity against *Aspergillus niger*. The aqueous extract showed similar responses in doses of 5-200 mg./kg. Alcoholic extract up to 200 mg./kg. i.p. did not cause any mortality. Oral feeding of the extract (100 mg./kg.) for 15 days to rats showed liver damage and loss of weight (Khonde *et al.*, 1971).

A few new esters of retronecine and platynecine were prepared for studying their pharmacological activity. Some of these compounds have shown local anaesthetic action.

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Platynecine -7, 9-senecioate was found to be the most potent compound in the series. These esters also had some local irritant effects (Puri *et al.*, 1972).

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## CROTON (Euphorbiaceae)

*C. OBLONGIFOLIUS* Roxb.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Baragachi | Mal. | — | Kote putol |
| Hind. | — | Chucka | Mar. | — | Ganasura |
| Kon. | — | Ghansurang | Tam. | — | Bhutankusam, railpoondu |

**Habitat :** Found in Bengal, Bihar, south India, Deccan, Burma and Ceylon.

**Parts used :** Root, bark, leaves and fruit.

**Ayurvedic description**

Sanskrit : *Naagadanti*

Synonyms : *Jayapaala, nepaala, datnibeeja, tintideephala,*

Properties :

| | | |
|---|---|---|
| *Rasa* | — | *Katu* |
| *Guna* | — | *Guru, snigdha, teekshna* |
| *Veerya* | — | *Ushna* |
| *Vipaaka* | — | *Katu* |

Actions/Uses : *Medhakara, vishadoshagna, pachanee, krimihara, virechani, deepani, jalodaranaashani, sarpadashtavishaghna, shoolaghna, udaravyaadhighna, kanthadoshahara*

**Medicinal properties and uses :** Bark and root are alterative and cholagogue. Seeds are purgative (Nadkarni, 1954).

**Pharmacognosy :** Macroscopical and microscopical studies of the root, stem and leaves of *C. sparsiflorus* have been carried out (Bhatnagar and Mann, 1971).

Hastidanti, a purgative root drug, has been identified variously as *C. oblongifolius* and *Citrullus colycynthis* (Krishnamurthy, 1969).

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**Chemistry :** Oblongifoliol, $C_{20}H_{22}O_2$ and deoxyoblongifoliol $C_{20}H_{32}O$ were isolated from the bark of *C. oblongifolius* and were assigned structures (Rao *et al.*, 1968, Aiyer *et al.*, 1969). Their structures have been revised on the basis of detailed chemical and spectral data. Evidence has been presented to assign the stereochemistry at C-13 as α-methyl and β-vinyl positions. The orientation at C-10 as α and as β has been confirmed by ORD study. Additional evidences were provided to confirm the position of the hydroxyls in oblongifoliol at position 3 (Aiyar and Seshadri, 1971*a*).

Besides diterpenes, a triterpene acid, acetyl aleuritolic acid has been isolated from the bark of *C. oblongifolius*. Its constitution has been established by physical and chemical methods. The co-occurrence of di- and triterpenes is very rare and is of biogenetic significance (Aiyar and Seshadri, 1971*b*).

Sparsiflorine has been isolated from the leaves of *C. sparsiflorus* as an amorphous powder, molecular formula $C_{17}H_{17}O_3N$, m.p. 230-232°. The structure of sparsiflorine has been found to correspond to N-nor-apoglazionine and is a position isomer of apocrotonosine and N-methyl sparsiflorine methiodide (Chatterjee *et al.*, 1965).

The properties and reactions of crotoflorine with its mono and di-acetates were studied and it was shown to be a proaporphine base which on acid-catalysed transformation, followed by basification yielded a known aporphine alkaloid sparsiflorine (Chatterjee and Majumdar, 1968).

Reinvestigation of the alkaloids of *C. sparsiflorus* resulted in the isolation of a new proaporphine base, $C_{17}H_{17}NO_3$, m.p. 193-195°, from the extracts of the whole plant and has been designated as crotsparine, which is different from sparsiflorine, an amorphous base previously isolated from the same plant. But a second base m.p. 125-127° $C_{19}H_{21}NO_3$, isolated with crotsparine proved to be identical with pronuciferine. The structure of crotsparine has been given. It is of interest that *C. sparasiflorus* collected around Calcutta yielded crotsparine with negative rotation whereas the same plant collected in Lucknow gave crotsparine with positive rotation (Bhakuni and Dhar, 1968).

Further search for new bases from *C. sparsiflorus* yielded a new dihydroproaporphine alkaloid $C_{17}H_{19}NO_3$, m.p. 184-185°, provisionally designated as crotsparinine. It has been assigned a structure on the basis of data obtained by UV spectrum, mass spectrum and NMR spectrum studies (Bhakuni and Dhar, 1969).

Alkaloids, amino acids, carbohydrates, flavonoids, mucilages, and steroids have been detected on preliminary screening from various extracts of stem of *C. sparsiflorus*. The petroleum ether extract on column chromatography gave four compounds, one of which has been identified as β-sitosterol (Bhatnagar and Mann, 1971).

**Pharmacology :** Intravenous administration of crotsparine produced a transient pressor response in anaesthetized cats in low doses and a depressor response in high doses. Pressor response to adrenaline was, however, reversed by all the doses employed. It had no effect on the depressor responses to acetylcholine and histamine and on the response of the nictitating membrane to preganglionic stimulation.

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N-methyl crotsparine, obtained by conversion of crotsparine, had a stimulant action on gross behaviour of mice with an acute $LD_{50}$ of 275.0 mg./kg., intraperitoneally. On intravenous administration, it produced a sharp initial fall followed by gradual sustained hypotension. The initial fall was found to be due to N-methyl-dihydrocrotsparine and could be prevented by pretreatment with atropine. The sustained hypotension was unaltered by atropine and mepyramine. The compound also depressed the heart both *in vitro* and *in vivo*.

Apo-N-methylcrotsparine, a compound derived from N-methyl crotsparine also produced hypotension similar to that of N-methyl crotsparine. It also produced a 10 per cent block of neuro-muscular transmission (non-depolarising type) for 30-60 minutes (Dubey *et al.*, 1969).

The mechanism of the hypotensive activity of N-methyl crotsparine has been studied. The hypotensive effect was not abolished by pretreatment with mepyramine or atropine, vagotomy, spinal section or decerebration. The hypotensive activity appeared to be mainly associated with negative inotropic effect and direct depression of supraspinal vasomotor loci (Dubey *et al.*, 1971).

N-methyl dihydrocrotsparine (5-10 mg./kg. i.v.) produced sharp but short lived fall on blood pressure (15-20 min.) which could be antagonised by atropine. O-N-dimethyl crotsparine methiodide produced similar hypotension for a shorter duration (45 minutes with 5·0 mg./kg i.v.). N-methyl apocrotsparine methodide produced hypotension and neuromuscular blockade. The potency and duration was similar to that produced by N-methyl crotsparine. The compound also produced α-adrenergic blockade of the same magnitude and the duration of neuromuscular blockade was dose dependant, 10 mg./kg. i.v. producing 100 per cent blockade lasting for about an hour. The block was non-depolarising type and could be reversed by neostigmine (Dubey *et al.*, 1970).

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## CRYPTOCARYA (Lauraceae)

*C. BOURDILLONI* Gamb.

**Chemistry*** : A new lactone cryptocaryalactone, $C_{17}H_{18}O_4$, m.p. 124-126° isolated from the roots of *C. bourdilloni* has been assigned a structure. It exhibited spectral properties suggestive of the presence of an acetoxyl group, styryl moiety and an α-β-unsaturated 6-membered lactone. Cryptocaryalactone represented the first example of a naturally occurring Kawa-type lactone arising by the condensation of three acetate units to cinnamic acid (Govindachari and Parthasarathy, 1971).

### Reference

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## CRYPTOLEPIS (Asclepiadaceae)

*C. BUCHANANI* Roem. and Schult.

Hind. — Karanta
Mal. — Kalipalvalli
Tel. — Adavipalatige

*No report available on other aspects.

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**Habitat :** Found thryughout India.

**Parts used :** Leaves.

**Ayurvedic description**

Sanskrit : *Krishna saariva*

Synonyms : *Ananta, gopakanyaa, gopavalli, gopasutaa, gopa, gopaangana, shwetare-khaankitachchada, gopi, daadimapatra, dugdhagarbha, shimbeephala, toolinee, krishnavallaree, jamboopatra, vallee, swanaamaprasiddha, chandanagandha.*

Properties :
*Rasa* — *Madhura, tikta*
*Guna* — *Guru, snigdha*
*Veerya* — *Sheeta*
*Vipaaka* — *Madhura*

Actions/Uses : *Shukrakara, agnimaandyahara, aruchihara, shwaasaghna, kaasaghna, jwaraghna, ateesaaraghna, vaataraktahara, kandooghna, kushtaghna, mehaghna, sangraahee, raktapittaghna.*

**Medicinal properties and uses :** The plant is used in preparations given to children as acure for rickets (Chopra *et al.*, 1956).

**Pharmacognosy*** : There are three different plant species *viz. Hemidesmus indicus, Ichnocarpus frutescens* and *Cryptolepis buchanani*, the roots of which are sold indiscriminately in the market as *Saariva*. Although the roots of these species are similar to each other, there are many salient features by which they can be differentiated.

Macroscopic characters : The external surface of the root is dark brown or blackish with a few transverse cracks. The cork is thin but does not separate from the phelloderm. Bark adheres closely to the wood and is odourless.

Microscopic characters : The primary stele is tetrarch. There are 5-8 layers of cork cells. Phelloderm fibres are present. Phloem fibres are numerous, occurring in concentric groups of 4-12 cells and rarely in singles. Crystal fibres and tyloses in xylem vessels are also present. Intraxylary phloem is absent. Fluorescence characteristics and ash values have been recorded (Wahi *et al.*, 1971).

**Reference**

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*No report available on other aspects.

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## CRYPTOSTEGIA (Asclepiadaceae)

*C. GRANDIFLORA* (Roxb.) Br.

Mar. — Vilayati-vakhandi Tam. — Paalai

**Habitat :** Largely cultivated in gardens throughout India, has become naturalized in Bombay and Madras and certain localities in Punjab, Uttar Pradesh and Delhi.

**Parts used :** Leaves.

**Pharmacology* :** The aqueous solution of the alcoholic extract of the aerial parts of *C. grandiflora* exerted significant hypoglycaemic action in normal rabbits which was attributed to hepato-toxic action. An increase in serum alkaline phosphatase was found in normal rabbits after one hour of administration of the extract which persisted for four hours, suggesting a hepato-toxic action of the extract. Since the serum alkaline phosphatase was found already raised in diabetic rabbits, an increase in this enzyme in the serum was not discernible (Sharma *et al.*, 1967).

The extract failed to reduce the blood sugar of alloxan diabetic rabbits. This could perhaps be attributed to the already deranged liver in alloxan diabetes (Sharma, *et al.*, 1967).

The aqueous extract of the leaves was found to have hypoglycaemic activity in both normal and alloxan diabetic rabbits (Bapat *et al.*, 1970).

### References

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## CUCUMIS (Cucurbitaceae)

*C. PROPHETARUM* Linn.

Hind. — Kharindroyan Sans. — Aindri
Mar. — Kanteindryan

*No report available on other aspects.

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**Habitat :** Grows wild on waste lands in Sind, Baluchistan Rajasthan and Deccan.

**Parts used :** Whole plant and fruit.

**Medicinal properties and uses :** Plant is emetic and purgative. Fruit pulp contains a bitter resinous substance, myriocarpin, which produces nausea and is slightly purgative (Chopra *et al.*, 1956).

**Chemistry :** The bitter principles cucurbitacin C (triterpenoid glucoside) was isolated and its chemical properties studied and compared with other bitter principles (Rao and Row, 1968).

**Pharmacology :** Pharmacodynamic investigations on the diuretic activity of the ether extract of the seeds of *C. melo* have been done in anaesthetised dogs. For continuous urine collection the ureters of the dog were exposed and catheterized with polythylene catheters. The extract produced a very significant increase in the renal creatine and chloride clearances. The extract was found to exert its effect upon renal glomerulus and possibly had some effects upon the renal tubular reabsorption of some of the electrolytes, similar to that of mercurial diuretics. The diuretic and chloruretic effects of the extract could be completely inhibited by prior administration of GAL and/or EDTA indicating that the drug possibly had a similar mechanism of action to that of mercurial diuretics which acted by suppressing the renal tubular chloride reabsorption, particularly in the distal renal tubules (Singh and Sisodia, 1970).

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Singh, R.C.A. and Sisodia, C.S. 1970. Pharmacodynamic investigations into the diuretic activity of *Cucumis melo* seed (Ether extract). **Indian J Med Res 58,** 505.

## CUCURBITA (Cucurbitaceae)

*C. MAXIMA* Duchesne

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Saphurii | Kon. | — | Duddini |
| Eng. | — | Great pumpkins, spanish gourd | Mal. | — | Chakkerakumpalan |
| | | | Mar. | — | Lal or tambda bhopla |
| Kan. | — | Kumbala | Tam. | — | Pooshani |
| Hind. | — | Kashiphal, Kaddu | Tel. | — | Gummadi karji |

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**Habitat :** This creeper is grown frequently all over India for its edible fruits.

**Parts used :** Seeds, pulp and fruit stalk.

**Medicinal properties and uses :** Seeds are anthelmintic, taenecide and diuretic. Oil from the seeds is a nervine tonic (Nadkarni, 1954).

*C. PEPO DC.* (Syn. *Lygenaria vulgaris* Serinap).

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Shada Kumra | Hind. | — | Lauki |
| Kan. | — | Sorekaayi | Mar. | — | Kaula |
| | | | Tam. | — | Pottaigummadi |

**Habitat :** Cultivated all over India.

**Parts used :** Seeds and leaves.

**Ayurvedic description**

Sanskrit : *Alaabu*

Synonyms : *Tumbee, deergha, vartula*

Properties :

| | | |
|---|---|---|
| *Rasa* | — | *Madhura* |
| *Guna* | — | *Guru, snigdha, sara* |
| *Veerya* | — | *Sheeta* |
| *Vipaaka* | — | *Madhura* |

Actions/Uses : *Hridya, vrishya, balya, ruchya, dhaatupushtivardhaka*

**Medicinal properties and uses :** The seeds are anthelmintic and the leaves are used in burns (Nadkarni, 1954).

**Chemistry :** The mixed fatty acids of *C. maxima* seed oil were fractionated by liquid solid countercurrent distribution with urea. The percentage of fatty acid composition of oil was palmitic 21·5, stearic 8·4, oleic 27·9 and linoleic 43·1 (Tewari and Srivastava, 1968).

**Pharmacology :** The aqueous, ethereal and alcoholic extracts of the seeds of *C. maxima* were found to possess anthelminthic properties both *in vitro* and *in vivo*. The order of decreasing potency of the extracts in the *in vivo* studies was aqueous, alcoholic and ethereal whereas in the *in vivo* studies, the order was aqueous, ethereal and alcoholic. The extracts had a significant action on trematodes (*Fasciolopsis buski*) but not on nematodes (*Ascaris lumbricoides*) in the *in vitro* studies. Kymographic studies revealed that in

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trematodes there was an excitatory response which was followed by inhibitory effect, whereas in nematodes no such initial stimulation was recorded (Srivastava and Singh, 1967).

The fruit pulp of *C. pepo* was found to be highly nutritive since all important nutrients like proteins, carbohydrates and minerals were found to be present. Rat growth studies indicated that the fruit had a definite, although slight, supplementary nutritive value when added to poor south Indian diet. The optimum level of substitution of the pulp in the diet seemed to be near about 10 per cent (Gangadharam and Sirsi, 1955*a*).

The crude aqueous extract of the ripe fruit showed on *in vitro* studies that the extract inhibited growth of the virulent strains ($H_{37}R_4$) of *Mycobacterium tuberculosis* completely in 1/10,000 dilution and retarded more than 50 per cent of the growth in a 1/100,000 dilution. The crude extract showed *in vivo* an encouraging chemotherapeutic efficacy in mice infected with $H_{37}R_4$ strains of *M. tuberculosis*, as evidenced by slight increase in the survival time, diminished gross involvement of the lungs and the presence of more proliferative lesions. Peposin isolated from the acetone extract completely inhibited the growth of the virulent $H_{37}R_4$ strain in a dilution of 1/50,000 for a period of 3 weeks (Gangadharam and Sirsi, 1955*b*).

### References


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Tewari, J.P. and Srivastava, M.C. 1968. Fractionation of fatty acids of *Cucurbita maxima* seed oil with urea. **J Pharm Sci 57,** 328.


## CUPRESSUS (Cupressaceae)

*C. SEMPERVIRENS* Linn.

Hind. — Sara
Mar. — Saruboke
Sans. — Suraahva
Tam. and Mal. — Suram

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**Habitat :** The tree is known only in the cultivated state in north-west India. The wild form is a native of Asia minor, Syria and North Persia.

**Parts used :** Wood and fruits.

**Medicinal properties and uses :** Wood is astringent and the fruits are anthelmintic (Nadkarni, 1954; Chopra *et al.*, 1956).

**Chemistry* :** Cupressuflavone, a new member of the biflavone group was isolated from *C. sempervirens* (Murti *et al.*, 1964).

L-fructose and DL-arabinose have been identified in the fruits of *C. torulosa*. The total percentage of carbohydrates in the fruits was 32·5 per cent (Prakash and Sinha, 1972).

### References

Murti, V.V.S., Raman, P.N. and Seshadri, T.R. 1964. Cupressuflavone, a new member of the biflavonyl group. **Tetrahedron Lett 39,** 2995.

Prakash Satya and Sinha, G.K. 1972. Chemical examination of carbohydrates in the fruits of *Cupressus torulosa* D. Don. and *Eucalyptus globulus*. **J Res Indian Med 7,** 67.

## CURCULIGO (Amaryllidaceae)

*C. ORCHIOIDES* Gaertn.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Talamuli | Mal. | — | Nellapana kilongu |
| Eng. | — | Black musale | Mar. and | | |
| Guj. | — | Musalikand | Kon. | — | Bhuyimaddi |
| Hind. | — | Kalimusli | Tam. | — | Nilappanaikizhangu |
| Kan. | — | Neladaali | Tel. | — | Naelatadi-kilangu |

**Habitat :** Occurs wild in sandy regions of hotter parts of India and Ceylon. It is the Kala-musli (black variety) of the commercial market and has to be distinguished from

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the tuberous root of *Asparagus adscendens* which goes by the name of "Safed musli" (white variety).

**Parts used :** Tuberous roots and bulbs.

**Ayurvedic description**

Sanskrit : *Krishna musalee*

Synonyms : *Taalamooli, taalapatraka, bhootalee, varshaabhv deerghakandika*

Properties :

| | | |
|---|---|---|
| *Rasa* | — | *Madhura, tikta* |
| *Guna* | — | *Guru, snigdha* |
| *Veerya* | — | *Ushna* |
| *Vipaaka* | — | *Madhura* |

Actions/Uses : *Vrishya, shukrala, brihmana, rasaayana, mootrala, mahaakushtaghna.*

**Medicinal properties and uses :** It is a bitter aromatic tonic, demulcent, diuretic and restorative. Roots are alterative and tonic (Nadkarni, 1954). It is also used in the treatment of asthma, jaundice, piles, diarrhoea, colic and skin diseases.

**Pharmacognosy* :** The characteristics of the rhizome have been studied.

Macroscopic characters : Rhizome is stout, 6-14 cm. long, with upper portion clothed with withered leaf bases and with copious fleshy lateral roots. Skin of the rhizome is yellowish brown and thin, fracture is starchy and odour is indistinct with a bitter taste.

Microscopic characters : Cork is composed of five layers of rectangular, tangentially elongated yellowish brown, suberized cells, containing numerous globules of an oily substance. The phellogen consists of one or two layers of rectangular cells. The phelloderm is not distinguishable from the cortex. Cortical cells contain starch grains and acicular crystals of calcium oxalate. Secretory cells are of schizogenous origin. A few collateral vascular bundles are scattered in the cortex. Endodermis and pericycle are not distinguishable. Stele is demarcated from the cortex by a layer of ground parenchyma cells with thick, cellulosic walls, traversed by simple large pits. The vascular bundles are from collateral to amphivasal type. Isolated long fibres with tapering ends are present. Crystals, secretory cells and starch grains also occur in the stellar parenchyma. The powdered drug is greyish brown to dull brown in colour with an indistinct odour and a slightly bitter taste (Bisht and Nayar, 1960).

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*No report available on other aspects.

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**Reference**

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## CURCUMA (Zinziberaceae)

*C. AMADA* Roxb.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Amada | Kan. | — | Mavinakaayi shunthi |
| Eng. | — | Mango ginger | Kon. | — | Amba-halad |
| Hind and Mar. | — | Amahaldi | Tam. | — | Arukamlaka, Manjal |
| | | | Tel. | — | Shadgrandika |

**Habitat :** Grown in Bengal and on the hills of west coast of India.

**Parts used :** Rhizome.

**Ayurvedic description**

Sanskrit : *Amragandhiharidraa*

Synonym : *Sugandhi*

Properties : *Rasa* — *Madhura*
*Guna* — *Rooksha, laghu*
*Veerya* — *Shəeta*
*Vipaaka* — *Katu*

Actions/Uses : *Sarvakandoovinaashini*

**Medicinal properties and uses :** It is a carminative, cooling, aromatic, bitter, stomachic and astringent (Nadkarni, 1954).

*C. LONGA* Linn.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Halud | Kash. | — | Lidar |
| Eng. | — | Turmeric | Mal. | — | Manjal |
| Guj. | — | Halder | Mar. and Kon. | — | Halad |
| Hind. and Punj. | — | Haldi | Tam. | — | Manjal |
| Kan. | — | Arisina | Tel. | — | Pasupu |

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**Habitat :** Extensively cultivated all over India. In Bombay, there are two varieties; one with hard rich-coloured oval rhizomes, chiefly used in dyeing, known as "Lokhandi Halad" and the other with soft, lighter coloured long rhizomes which are usually used for edible purpose.

**Ayurvedic description**

Sanskrit : *Haridraa*

Synonyms : *Kaamini, nishaa, varnini, gaura, krimighni, yoshitpriya, kaanchani, varavarnini, haladi, hattaavilasini.*

Properties : *Rasa* — *Tikta, katu*
*Guna* — *Rooksha, laghu*
*Veerya* — *Ushna*
*Vipaaka* — *Katu*

Actions/Uses : *Varnya, twagrogaghna, mehaghna, raktadoshahara, kandooghna, paandughna, vranahara, vishaghna, vishodhini, peenasanaashini, aruchighna, shoshaghna*

**Medicinal properties and uses :** They are aromatic, stimulant, tonic and carminative. Internally its juice is an anthelmintic (Nadkarni, 1954).

**Pharmacognosy :** The rhizomes and roots of *C. amada* commonly known as "Amragandhi" have been studied. The rhizome pieces are 3·0 to 10·0 cm. long and 1·0 to 3·5 cm. broad, laterally compressed and pale brown in colour. The roots are 1·0 to 15·0 cm. long and 0·5 to 2 mm. in diameter and of brownish colour. Microscopically the rhizome shows on outer zone of cork, followed by cortex, the outer zone containing numerous oil cells and starch grains. The inner zone consists of closed vascular bundles. Endodermis is present. The vascular bundles are arranged in a ring immediately within the pericycle and some are also scattered. The centre of the stele is parenchymatous containing abundant starch grains and oil-cells.

The root shows epidermis, followed by a wide zone of cortex containing air-canals and thick walled endodermis. The pericycle encloses the stele consisting of a number of xylem and phleom strands, alternating radially. The pith is present in the centre (Mitra and Kapoor, 1971).

There is no well recognized variety of *C. longa* and samples of one place differ from those of another. In order to find out the variation in different samples, dry uncured turmeric was examined. The yield of fatty oils varied in different samples from 4·40—12·73 per cent, essential oil 4·20—14·00 per cent, moisture 10·00—12·00 per cent, total ash 5·95—13·10 per cent and acid insoluble ash 0·50—2·15 per cent.

In another study 9 samples of cured turmeric were procured and analysed. These contained fatty oil 1·74—3·32 per cent, essential oil 2·40—4·00 per cent, moisture

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3·00—7·00 per cent, total ash 4·70—8·20 per cent and acid insoluble ash 0·65—1·73 per cent (Mehra and Puri, 1971).

**Chemistry :** The important colouring matter of *C. longa* is curcumin which belongs to the dicinnomoyl methane group. The tubers also yield an aromatic oil called turmeric oil.

Synthesis of terpenoids (+)—juvabione and +—ar—juvabione and conversion of turmerone to (+)—ar—juvabione has been reported (Subramanian and Rao, 1967).

**Pharmacological and clinical studies :** The petroleum ether extract and two of its fractions i.e. A (viscous oil) and B (crystalline solid) of the rhizomes of *C. longa* were found to have significant anti-inflammatory activity in rats which compared favourably with hydrocortisone acetate and phenylbutazone. Both the fractions reduced the histamine content of the rat skin to about 50 per cent of the control values, whereas hydrocortisone acetate decreased the histamine content to 58 per cent of the controls. Fractions A and B reduced the SGOT (serum glutamic oxalo acetic transaminase) and SGPT (serum glutamic pyruvic transaminase) levels in formalin-induced arthritic rats. The extract did not show any significant toxic effects (Arora *et al.*, 1970, 1971).

The volatile oil obtained from the rhizome given orally (0·01 ml./kg.) was compared with cortisone acetate (10 mg./kg.) against adjuvant arthritis in rats. The drug was found to have significant effect in suppressing the primary swelling on the 3rd day of the injection of adjuvant as also the secondary swelling which appeared on the 13th day. The protective effect of the volatile oil of *C. longa* in early inflammatory lesions has been attributed to the anti-histaminic effect, while activation of adrenohypophyseal axis by the oil may be responsible for inhibition of the late arthritic changes (Chandra and Gupta, 1972). The anti-inflammatory effect of the volatile oil has been found to be greater than that of hydrocortisone in experimentally induced oedema and arthritis (Katare-personal communication).

The anti-inflammatory activity of *C. longa* has been investigated with reference to the inhibition of activated proteases responsible for acute inflammatory processes. The volatile oil of the plant was found to inhibit trypsin as well as hyaluronidase enzymes (Tripathi *et al.*, 1973).

Curcumin, isolated from the rhizomes was found to inhibit the carrageenin-induced oedema in rats as well as in mice. The regression line in both cases parralleled that of cortisone but not of phenyl butazone and the effect was significantly less in adrenalectomised rats, suggesting an indirect mechanism of action. It also inhibited formalin-induced acute oedema in mice as well as subacute arthritis in rats. Curcumin inhibited cotton pellet-induced granuloma formation in rats. It did not show any activity in phenylquinine induced writhing test upto a dose of 160 mg./kg. p. o. (Srimal *et al.*, 1971).

The petroleum ether, alcoholic and aqueous extracts of the rhizome of *C. longa* showed 80 per cent, 60 per cent and 100 per cent antifertility activity in albino rats

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at a dose of 100 mg./kg. body weight respectively. The petroleum ether extract also caused resorption of the implants (Garg, 1971).

Fresh extract of *C. longa* was found to possess considerable inhibitory action on contractions induced by acetylcholine, histamine and barium chloride on isolated guinea-pig ileum, rabbit intestine and rat uterus (Sinha *et al.*, 1970).

Curcumin, in a dose of 7·5 mg./kg. caused a sharp but transient fall of blood pressure which was not blocked by atropine, anti-histamines or β-blockers. On isolated heart of guineapig, curcumin revealed a depressant effect. The drug also showed marked spasmolytic effect against various spasmogens on isolated tissues (Sinha *et al.*, 1972).

A clinical trial with *Haridra* was conducted in 114 patients of respiratory diseases consisting of 71 cases of bronchitis, 13 cases of bronchiectasis, 18 cases of bronchial asthma and 12 cases of tropical eosinophilia. The drug was administered in gradually increasing doses from 4 to 32 g. daily for a period of 15 to 45 days. Significant improvement in signs and symptoms and relief in airway resistance was observed in 11 cases of bronchitis, one case of bronchiectasis, 5 cases of bronchial asthma and 6 cases of tropical eosinophilia. In 29 patients, airway obstruction was re-assessed after administration of parenteral aminophylline and in 14 cases after sublingual isoprenaline administration. Further reduction in the airway resistance in 13 cases of bronchitis and 3 patients of tropical eosinophilia was observed after isoprenaline administration whereas no additional reduction in airway resistance was observed in 21 patients of bronchitis, bronchiectasis, bronchial asthma and tropical eosinophilia after administration of aminophylline or isoprenaline. *Haridra* had no eosinopoenic effect in cases of tropical eosinophilia. (Shankar—Personal communication).

Studies on the effect of the alcoholic and ethereal extracts of the rhizomes of *C. longa* and *C. amada* on the cholesterol levels in experimental hypercholesterolemia in rabbits revealed that only the ethereal extract of *C. amada* in a dose of 1 g. given orally in the form of aqueous suspension could lower the blood cholesterol level (Pachauri and Mukherjee, 1970).

*Curcuma* powder has been found to increase appreciably the mucin content of gastric juice in rabbits. The beneficial effects of *Curcuma* powder as a therapeutic agent in gastric disorders might possibly be due to its mucus stimulatory effect (Mukherjee *et al.*, 1961).

Curcumin, its alkali salts and the oil did not afford any protection against histamine-induced gastric ulceration in guineapigs (Bhatia *et al.*, 1964).

Sodium curcuminate isolated from *C. longa* has been found to be an active choleretic. It induced nearly 100 per cent increase of bile production in anaesthetized dogs, in doses non-toxic to the animals. The essential oil and some of its fractional distillates also induced choleresis but to a less extent than the pigment (Ramprasad and Sirsi, 1956). Sodium curcuminate was found to stimulate bile flow by acting as a hydrocholagogue. In spite of a decrease in the concentration of solids in the bile, the

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total amount of solids excreted during the entire period of activity of the drug was found to be increased. The increased bile salt excretion seems to favour the use of curcumin in digestive disorders. Curcumin had a stimulant effect on the musculature of gall bladder, unlike the other bile stimulants in clinical use. Curcumin seemed to combine the choleretic and hydrocholagogic action with antiseptic property and thus would be an ideal therapeutic agent in conditions of the biliary systems and gall bladder due to suspected staphylococcal infection. The drug had low toxicity (Ramprasad and Sirsi, 1957*a*). Sodium curcuminate has been shown to influence differently the individual constituents of the bile. Though the concentration of solids decreased in the bile after administration of the drug, an increase in the volume of bile secreted was observed. Absolute values for the entire period of choleresis indicated an increase in total excretion of bile salts, bilirubin and cholesterol. The fatty acid content remained almost constant (Ramprasad and Sirsi, 1957*b*).

The antibacterial activity of *C. longa* was compared with that of penicillin on gram-positive organisms and that of streptomycin on gram-negative organisms. It was found that the activity against gram-positive and gram-negative organisms was lesser in degree as compared to penicillin and streptomycin (Basu, 1971).

The alcoholic extract of the rhizomes of *C. longa* was found to have anti-protozoal activity against *Entamoeba histolytica* (Dhar *et al.*, 1968). The extracts of rhizomes of *C. caesia*, *C. amada*, *and C. aromatica* were found to have CNS depressant activity in mice (Bhakuni *et al.*, 1969).

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## CUSCUTA (Convolvulaceae)

*C. REFLEXA* Roxb.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Algusi | Mar. | — | Nirmuli |
| Eng | — | Dodder | Punj. | — | Nilathari |
| Guj. | — | Akaswel | Tam. | — | Akashaavalli |
| Hind. | — | Akasbel | Tel. | — | Sitama purgonalu |

**Habitat :** Common throughout India, abundant in Bengal. It has no underground root, but only grows as a parasitic twiner on other plants. It grows during rainy season and every year the growth is fresh on the same plant.

**Parts used :** Seed, stem and fruit.

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**Ayurvedic description**

| | | | |
|---|---|---|---|
| Sanskrit : | *Amaravallari, Aa-kaashavalli* | | |
| Properties : | *Rasa* | — | *Tikta, kashaaya* |
| | *Guna* | — | *Laghu, pichchilla* |
| | *Veerya* | — | *Sheeta* |
| | *Vipaaka* | — | *Katu* |
| Actions/Uses : | *Vedanaasthaapani, keshya, shophaghna* | | |

**Medicinal properties and uses :** Plant is alterative, purgative, and anthelmintic; seeds are carminative and anodyne. Stem is purgative (Nadkarni, 1954).

**Chemistry :** As a result of chemical study by different groups of workers on *C. reflexa*, it is now known that there is definite variation in the chemical composition of this plant. On a detailed chemical examination of its stem, a colouring matter (cuscutin) and a lactone (cuscutalin) were isolated (Agarwal and Dutt, 1935). Neither of these could be obtained by subsequent workers. Later, β-sitosterol and an unidentified flavonoid pigment were isolated (Gopinath *et al.*, 1962). Isolation of dulcitol (6 per cent) from *C. reflexa* growing on *Melia azadirachta*, *Eugenia jambolana* and *Anacardium occidentale* and mannitol (5 per cent), an isomer of dulcitol from *C. reflexa* growing on *Santalum album* were reported (Subramanian and Nair, 1963, 1964*a*). Another variation was observed by isolating the C-glucoside bergenin and a coumarin derivative. Cuscutin was found to be impure bergenin (Jain and Mishra, 1963).

Most of the workers have found that the flavonoid kaempferol and its 3-glucoside constitute the colouring matter, but *C. reflexa*, parasitic on *Glycosmis triphylla*, contained luteolin instead of kaempferol (Subramanian and Nair, 1964*b*). The report of the isolation of a flavone pigment amarkelin was not confirmed by any subsequent work. However, Gopinath *et al.* (1962) and Subramanian and Nair (1963) identified kaempferol in certain samples, and the latter reported kaempferol and myricetin as occurring in the berries of *C. reflexa* parasitic on *Melia azadirachta*. It may be observed here that most of the workers have not made specific mention of the host plant from which the parasite was collected for investigation.

Mangiferin was found to occur in *C. reflexa* growing on *Mangifera indica* and this provided evidence regarding the direct influence of the host-plant on the chemical components of the parasite (Subramanian and Nair, 1966).

**Pharmacology :** Freshly prepared aqueous and alcoholic extracts of *C. reflexa* were found to have a relaxant and spasmolytic action on the small intestine of guineapig and rabbit. The extracts showed acetylcholine-like action on the isolated ileum of guineapig and rabbit, frog's rectus muscle and dog's blood pressure and small intestine *in situ*. However, the spasmodic action on guineapig and rabbit uterus was not blocked by atropine.

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The plant had no action on rat's uterus. In atropinized rabbit's auricles and frog's heart, it produced marked cardiotonic activity (Prasad, 1965).

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## CYCLEA (Menispermaceae)

*C. BURMANII* Miers. (Syn. *C. peltata* H.f. and t.)

| | | | | | |
|---|---|---|---|---|---|
| Guj. | — | Kelipar | Kon. | — | Paral, parawal |
| Hind. | — | Parvel | Tam. | — | Para |

**Habitat :** Found wild from Konkan down to Ceylon and from Assam and Khasia hills eastwards.

**Parts used :** Roots.

**Medicinal properties and uses :** Roots are used in jaundice and as stomachic; also in fever, leprosy and asthma (Chopra *et al.*, 1969).

**Chemistry** * : Two alkaloids having m.p. 220° and 165° and D-quercitol, m.p. 235° have been isolated from the roots. The principal base with m.p. 220°, $C_{38}H_{22}O_6N_2$ has been found to be identical with tetrandine (Chaudhury and Dhar, 1958).

*No report available on other aspects.

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Three more alkaloids were later isolated from the roots, out of which one was identified as burmannaline $C_{21}H_{23}NO_4$, m.p. 185-186°, base C with m.p. 320° and base D with m.p. 209-210°. These were isolated from the acetone extract in addition to tetrandine (Saradamma, 1964).

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## CYMBOPOGON (Gramineae)

*C. CITRATUS* DC. (Syn. *Andropogon citratus* DC.)

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Gandhabena | Mar. | — | Vasanapillu |
| Guj. | — | Gandha-bela | Punj. | — | Khawi |
| Hind. | — | Gandhatrina | Tam. | — | Vaasanaippul |
| Kan. | — | Majjige-hullu | Tel. | — | Nimmagaddi |

**Habitat :** Grows in gardens in Punjab, Bombay and Gujarat also found wild in Mysore.

**Parts used :** Essential oil and leaves.

**Medicinal properties and uses :** Infusion of leaves is sudorific and stimulant. Oil is carminative and also given in cholera (Chopra *et al.*, 1956; Nadkarni, 1954).

*C. NARDUS* (Linn.) Rendle (Syn. *Andropogon nardus* Linn.).

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Kamakher | Mal. | — | Kamakshi-pillu |
| Eng. | — | Citronella | Tam. | — | Kamachipillu |
| Hind. | — | Ganjni | Tel. | — | Kamkshikasuvu |

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**Habitat :** Grows throughout the hotter parts of India, wild or cultivated. Common in south India.

**Parts used :** Essential oil and leaves.

**Medicinal properties and uses :** Infusion of leaves is stomachic and carminative. Oil is stimulant, carminative, antispasmodic, diaphoretic, sudorific and rubefacient (Chopra *et al.*, 1956; Nadkarni, 1954). The essential oil is used for the production of β-ionone, an intermediate in the synthesis of vitamin A.

**Pharmacognosy :** Planting stocks of *C. citratus* and *C. nardus* were obtained from various sources and cultivated. The application of ammonium nitrate, urea and indole-3-yl-acetic acid (IAA) enhanced the vegetative growth, the increase in the fresh weight of leaves being over 60 per cent. This increase in weight resulted in greater yield of volatile oils and their chief constituents (Kokate and Varma, 1971).

**Chemistry :** Several strains of *Cymbopogon* having high oil content have been studied. These could be used for commercial production of geraniol, geranyl acetate, citral, citronellal, piperiotone, perillyl alcohol and nerolidol. *C. nardus* gave 3·6 per cent oil containing 81 per cent total geraniol. Similarly *C. nardus* var. *winterianus*, *C. pendulus* and *C. citratus* gave 2·0 per cent, 2·8 per cent and 3·1 per cent oil respectively with citral as the major component in a yield of 81·5 per cent, 81·2 per cent and 73·8 per cent respectively. This study also brought to light the existence of chemical races within different *Cymbopogon* species (Thappa *et al.*, 1969).

**Pharmacology :** The essential oil obtained from the fresh leaves of *C. nardus* showed marked sedative effect in rats and decreased the spontaneous motor activity to a great extent. Ptosis was also marked and the animals moved about with an unsteady gait. The drug produced a fall in rectal temperature. The hypnosis caused by pentobarbitone sodium was markedly potentiated by the essential oil in mice. It was, however, found less effective in influencing the conditioned avoidance response (Kokate *et al.*, 1971).

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# CYNODON (Gramineae)

*C. DACTYLON* (Linn.) Pers.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Dubh | Mar. | — | Haryali |
| Hind. | — | Dhub | Tam. | — | Arugampullu |
| Kan. | — | Garike | Tel. | — | Harvali |

**Habitat :** Grows throughout India, up to 2600 m.

**Parts used :** Roots and juice of the plant.

**Ayurvedic description**

Sanskrit : *Doorvaa*

Synonyms : *Shataparna, shataveerya, golomee, vrikshaadani, lataa, payasya*

Properties :

| | | |
|---|---|---|
| *Rasa* | — | *Madhura, kashaaya, tikta* |
| *Guna* | — | *Laghu, snigdha* |
| *Veerya* | — | *Sheeta* |
| *Vipaaka* | — | *Madhura* |

Actions/Uses : *Raktapittahara, trishnaghna, arochakaghna, vaantihara, daahaghna, moorchaghna, shramahara, kandoohara, visarpaghna, twagrogaghna, garbhasraavahara.*

**Medicinal properties and uses :** Decoction of root is diuretic, used in dropsy and in secondary syphilis. Infusion of root is given for bleeding piles. Crushed roots mixed with curd is used in chronic gleet. Juice of the plant is astringent, used as an application to fresh cuts and wounds, diuretic, and also used in dropsy and anasarca, in hysteria, epilepsy, insanity, chronic diarrhoea and dysentery. It is reported to be useful in catarrah and ophthalmia (Chopra *et al.*, 1956).

**Pharmacology* :** An alkaloid isolated from the plant caused a slowing of blood flow in the mesentric capillaries of rats and mice. It increased the tonicity of the isolated ileum of guineapig. It reduced the blood sugar level in rabbits by 15 per cent at the end of the first hour. It also reduced clotting time and bleeding time in adult rabbits at a dose of 2·5 mg./kg. i.v.

A glycosidal fraction isolated from the plant caused hypotension in the cat (8-18 mg./kg.) but the action at a dose of 10 mg./kg. was antagonized by atropine. It lowered the blood sugar level in adult fasting rabbits by 7 per cent at the end of the first hour (10 mg./kg. i.v.). The gluco-alkaloid fraction caused an insignificant fall

*No report available on other aspects.

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in the blood pressure of cat. In fasting adult rabbits it caused a lowering of blood sugar by 3·1 per cent at the end of the first hour (Dutta—Personal communication).

The alcoholic extract of the entire plant *C. dactylon* was found to have antiviral activity against *Vaccinia virus* (Dhar *et al.*, 1968).

**Reference**

Dhar, M.L., Dhar, M.M., Dhawan, B.N. Mehrotra, B.N. and Ray, C. 1968. Screening of Indian plants for biological activity Part I. **Indian J Exptl Biol 6,** 232.

## CYPERUS (Cyperaceae)

*C. ROTUNDUS* Linn.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Moothoo | Kon. | — | Bhadramusti |
| Eng. | — | Nutgrass | Mal. | — | Karimuttan |
| Guj. | — | Barik motha | Mar. | — | Musta |
| Hind. | — | Korehi-jhar | Tam. | — | Korai |
| Kan. | — | Tangahullu, mustaa | Tel. | — | Tunga-musti |

**Habitat :** It occurs throughout the plains of India, specially abundant in south India.

**Parts used :** Tuber or bulbous root.

**Ayurvedic description**

Sanskrit : *Mustaka*

Synonyms : *Vaarida, ghana*

Properties : *Rasa* — *Katu, tikta, kashaaya*
*Guna* — *Laghu, rooksha*
*Veerya* — *Sheeta*
*Vipaaka* — *Katu*

Actions/Uses : *Graahi, deepaaa-paachana, raktapittahara, trishnaahara, pittajwaraghna, aruchihara, jantughna, ateesaaraghna.*

**Medicinal properties and uses :** It is a stimulant, tonic, demulcent, diuretic, anthelmintic, stomachic, carminative, diaphoretic, astringent, emmenagogue and vermifuge (Nadkarni, 1954).

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**Chemistry :** The essential oil from *C. rotundus* contained at least 27 components comprising sesquiterpene hydrocarbons, sesquiterpene epoxides, sesquiterpene ketones, monoterpene and aliphatic alcohols and some unidentified constituents. Some of the new sesquiterpenoids reported are : (+)—copadiene ; analysed for $C_{15}H_{22}$, b.p. 130-140° and is a conjugated diene; (+)—epoxyguaine; analysed for $C_{15}H_{24}O$, b.p. 102-104° and did not show any absorption of OH or C=O in the IR and hence denoting an ether. The structure has been established as (—) rotundone ; analysed for $C_{15}H_{22}O$, b.p. 128-129°. Its structure has also been determined. Hydroxyketone (cyperolone) was obtained as a very minor component, $C_{15}H_{24}O_2$, b.p. 120° (Kapadia *et al.*, 1967).

Isolation of about 15 components has been reported from the rhizome of *C. rotundus*. It is significant to note that all the basic skeletons (copane, selinane and guiane) known to occur in the essential oil require, as the initial step, a 1, 10-cyclisation of trans farnesol in their projected biogenesis and all the compounds isolated so far have the same absolute configuration at C-10 (Kapadia *et al.*, 1967).

Various characteristics of the essential oil obtained from the tubers of the plant were studied by chromatographic and spectroscopic methods (Kalsi *et al.*, 1969).

**Pharmacological and clinical studies :** The petroleum ether extract of the roots showed anti-inflammatory activity against carageenin- induced oedema in albino rats. A triterpenoid obtained by chromatographic separation from the petroleum ether extract revealed a highly potent anti-inflammatory activity which was found to be 8 times greater than that of hydrocortisone. Besides this, the fraction was found to possess antipyretic and analgesic effects. The $LD_{50}$ of the compound was 50 mg./kg. and $ED_{50}$ 1·6 mg./kg. intraperitoneally (Gupta *et al.*, 1970, 1971*a*).

The oil of *C. scariosus* was found to have potent anti-inflammatory activity in a dose of 100 mg./kg. intraperitoneally in rats against carrageen-induced oedema, adjuvant arthritis and cotton pellet induced inflammation. The activity of the extract was compared with phenylbutazone 100 mg./kg. orally and hydrocortisone acetate 5 mg./kg. intraperitoneally. The activity was found comparable to that of hydrocortisone acetate (Gupta *et al.*, 1971*b*, 1972).

A 2 per cent sterilized methanolic extract of the roots was tried in 26 hospitalized cases of conjunctivitis. The drug was found to be non-irritant and there was subjective as well as objective improvement within 24 hours (Saxena *et al.*, 1971).

The essential oil obtained from the tubers exhibited estrogenic activity. Out of the various fractional distillates, only the hydrocarbon fraction, cyperene I was active, though less potent than the oil (Indira *et al.*, 1965*a*). The essential oil also caused relaxation of the isolated uterus of guineapig and rat indicating the possibility of the drug being useful in spasmogenic pain associated with uterus (Indira *et al.*, 1956*b*).

Alcoholic extract of the tubers showed transquillising activity in rats. The extract had antipyretic activity and compared well with sodium salicylate in suppressing yeast-

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induced pyrexia in albino rats. It produced a persistent fall in the blood pressure of anaesthetized dogs. It had a smooth muscle relaxant effect on rabbit ileum. It also stimulated the respiration in mice, rats and anaesthetized dogs. Anti-emetic activity was noted as evinced by protection against apomorphine-induced emesis in dogs (Singh *et al.*, 1969, 1970).

The oil and its various fractions *viz.* hydrocarbon I (cyperene I), hydrocarbon II (cyperene II), hydrogenated compound of hydrocarbon II, alcoholic fraction (cyperol) and ketonic fraction (cyperone) were studied for their antibacterial activity against a number of organisms. Except cyperone, which was inert, the other fractions inhibited the growth of *Staphylococcus aureus*. The hydrocarbon fractions I and II were found to be more potent than the oil and cyperol (Radomir *et al.*, 1956).

The alcoholic extract of the whole plant *C. scariosus* antagonised the stimulant effects of histamine, bradykinin and serotonin on smooth muscles of guineapig ileum and rat uterus. The extract also produced a marked fall in blood pressure in rats which could be abolished by prior atropinisation. A higher dose of the extract in mice showed antitremorine and anti-convulsant activities (Sharma *et al.*, 1970).

The alcoholic extract of the entire plant *C. niveus* was found to possess anti-vira activity against *Ranikhet disease virus* (Dhar *et al.*, 1968).

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## DAEMI (Asclepiadaceae)

*D. EXTENSA* R. Br. (Syn. *Asclepias echinata* Herb, *Pergularia daemia* (Forsk.) Chior.)

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Chhagal bati | Mal. | — | Veliperitte |
| Guj. | — | Nagaladudheli | Punj. | — | Trottoc |
| Hind. | — | Utranajutuka | Tam. | — | Uttamani, veliparutti |
| Kan. | — | Talavaranaballi | Tel. | — | Jittupaku |
| Kon. and Mar. | — | Uttarani | | | |

**Habitat :** A common twiner found throughout India.

**Parts used :** Leaves, roots and root-bark.

**Medicinal properties and uses :** The plant is extremely irritant. Flowers and leaves are emetic, expectorant and anthelmintic, (Nadkarni, 1954).

**Chemistry* :** Two new sterols have been isolated and identified from the petroleum ether and alcohol extracts of the whole plant. Hentriacontane, lupol, α-amyrin and β-amyrin, β-sitosterol and betaine have been identified in the extracts. An unidentified alcohol, molecular formula $C_{35}H_{72}O$, m.p. 72-74° and an ester m.p. 82° which on hydrolysis gave n-pentacosanic acid have been isolated. The active principle has been found to be a polypeptide. No sugar has been detected in the active material (Rakhit *et al.*, 1959).

The most characteristic constituents of this asclepiadaceous plant are the cardenolides which were studied in great detail. Examination of the aerial parts (stem and seeds) of the plant showed the presence of about 10 cardenolide aglycones and

*No report available on other aspects.

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glycosides among which the following were identified : uzarigenin, cortoxigenin, coroglaucigenin, calotoxin, calactin, calotropin, calotropagenin and al-dihydro-calotropagenin (Mittal *et al.*, 1962).

The air-dried roots of *D. extensa* were extracted with light petroleum ether, acetone and alcohol. The light petroleum extract, on column chromatography, gave lupeol acetate, lupeol, β-sitosterol and α-amyrin acetate. The ether extract gave β-sitosterol-β-D-glycopyranoside. The acetone and alcohol extracts yielded calactin and calotropin and glycosides of uzarigenin and coroglaucigenin. In comparison with the aerial parts of the plant, the roots contained cardenolides in lesser amount and also in lesser number. Sucrose was found in the alcohol extract (Seshadri and Vydeeswaran, 1971).

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## DALBERGIA (Papilionaceae)

*D. LANCEOLARIA* Linn. (Syn. *D. frondosa* Roxb.)

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Chakeamdia | Tam. | — | Nalvelangu |
| Hind. | — | Bithua, gaurakh | Tel. | — | Erra-pachchari |
| Mar. | — | Kanrehi | | | |

**Habitat :** An ornamental plant, found in plains from western Himalayas down to Ceylon.

**Parts used :** Bark, oil from seeds, leaves and roots.

**Medicinal properties and uses :** Bark along with that of *Flacourtia ramonkhi* is used as an external application during intermittent fever. Its infusion is given internally in dyspepsia. Seed-oil is used in rheumatic affections (Chopra *et al.*, 1956; Nadkarni, 1954).

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*D. LATIFOLIA* Roxb. (Syn. *D. emarginata* Roxb.)

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Sitsal | Sans | — | Shimshapa, Krishnasaara |
| Mar. and Tam. | — | Kalasinsapa | Tel. | — | Cittegi |

**Habitat :** A tree growing in Maharashtra, Bengal, Bihar, Sikkim, Madhya Pradesh and western Peninsula.

**Parts used :** Bark and leaves.

**Medicinal properties and uses :** It is a bitter tonic, stimulant, appetiser and stomachic. It is also used in dyspepsia, diarrhoea, leprosy, obesity, worms *etc.* (Chopra *et al.*, 1956; Nadkarni, 1954).

*D. SISSOO* Roxb.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Sishu | Punj. | — | Talisafedar |
| Eng. | — | Black-wood | Tam. | — | Nuku-kattai |
| Hind. | — | Sisam | Tel. | — | Sissukarrha |
| Mar. | — | Tali | | | |

**Habitat :** It grows in western Himalayas upto 1500 m. It is extensively planted throughout India.

**Parts used :** Bark, roots, leaves and mucilage.

**Ayurvedic description**

Sanskrit : *Shimshapa*

Synonyms : *Krishnasaara, aguru, virittapatra, anupuspaka, shimbeephala, guchchapushpa*

Properties :
*Rasa* — *Kashaaya, katu, tikta*
*Guna* — *Laghu*
*Veerya* — *Ushna*
*Vipaaka* — *Katu*

Actions/Uses : *Kandooghana, Vastirogavinaashini, medahara, vranaghna, shophaghna, hikkaashamani, dushtavranashodhana, shwitraghna, vamishamana, krimighna, valasaaghna, garbhapaatini, visarpahara, balya, ruchya.*

**Medicinal properties and uses :** Bark or raspings of the wood are alterative while the roots are astringent and leaves bitter and stimulant. A decoction of leaves is found useful in gonorrhoea. The wood has been found useful in leprosy, boils, eruptions and to allay vomiting (Chopra *et al.*, 1956; Nadkarni, 1954).

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*D. VOLUBILIS* Roxb.

| | | | | | |
|---|---|---|---|---|---|
| Hind. | — | Bhatia | Tam. | — | Punali |
| Mal. | — | Rongdi | Tel. | — | Bandeegrjan |
| Mar. | — | Alai | | | |

**Habitat :** A tree of the sub-Himalayan tract from Kumaon eastwards, central and southern India.

**Parts used :** Leaves and roots.

**Medicinal properties and uses :** Juice of the leaves is applied in aphthae and used as a gargle in sore throat. Root-juice with cumin and sugar is given in gonorrhoea.

**Chemistry :** The root-bark of *D. lanceolaria* contained a new isoflavone glycoside, named lanceolarin. By physcial, chemical and degradative evidences its structure was deduced as 7-apiglucoside of biochanin-A. It was also shown that the positions of linkage between apiose and glucose were 1-2 and the glycosidic bonds were of β-configuration (Malhotra *et al.*, 1967).

The absolute configuration of latifolin from *D. latifolia* has also been worked out. Two quinones, the yellow and red, were formed from latifolin by reactions which did not involve the asymetric centre (Darshan *et al.*, 1966).

From the various extracts of bark and sapwood of *D. latifolia*, triacontane, acetyl oleanolic acid, β-sitosterol, γ-sitosterol, a mixture of β-sitosterol and campesterol dalbergichromene ; (R)-4-methoxy dalbergione; (R)—latifolin, lupeol, methyldalbergin and dalbergione have been isolated and characterised (Dhingra *et al.*, 1971).

The bark of *D. paniculata* was successively extracted with light petroleum ether, acetone and methanol. From these extracts β-sitosterol, biochanin A and formononetin and a new isoflavonoid-6, 8-di-C-glucoside designated as paniculatin were isolated. This glucoside on boiling with hydrogen iodide and phenol furnished genistein. This was proved by NMR data and degradative studies (Narayanan and Seshdari, 1971).

A thorough reinvestigation of the methanol extract of the bark has revealed, besides the already known compounds, the presence of sissotrin, ononin and three hitherto unknown glycosides as minor constituents. One of them is a C-glycoside of genistein monomethyl ether and its structure was established as 8-C-glycosyl prunetin (Parthasarthy *et al.*, 1974*a*). The remaining two new compounds were found to be 7-0-rutinosides of biochanin-A and of formenonetin by chemical, spectral and degradative evidences (Parthasarthy *et al.*, 1974*b*).

The wood of *Dalbergia* contains a new group of compounds, the neoflavonoids, having $C_{15}$ skeleton. From *D. sisso*, a compound was extracted named dalbergin, $C_{16}H_{12}O_4$, containing one phenolic hydroxyl and one methoxyl group and a lactone

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ring. Another compound isolated from the wood of *D. sissoo* has been named as dalbergichromene. The presence of numerous such compounds in this species is of biogenetic interest (Narayanan and Seshadri, 1970).

The stem-bark of *D. sissoo* also yielded besides dalbergenone, delbergin and methyl dalbergin, a new compound 4-phenyl chromene, dalbergichromene. Its structure has been determined as 7-methoxy-6-hydroxy-4-phenyl chrom-3-one by spectral and degradative experiments and confirmed by arrangement of dalbergenone to dalbergichromene. It is a pale yellow crystalline compound, m.p. 99-100°, $C_{16}H_{14}O_3$.

Reinvestigation of the heartwood showed that in addition to the known compounds, the plant also contained dalbergichromene, nordalbergin and isodalbergin as minor constituents. A new method of conversion of 4-phenyl-coumarins into 4-phenyl-chromenes involved cyclodehydration of the appropriate orthohydroxy cinnamyl alcohols (Mukerjee *et al.*, 1971).

The flavonoid and neoflavonoids of *Dalbergia* species have also been reviewed with related compounds (Seshadri, 1972).

**Pharmacological and clinical studies :** The crude decoction of the leaves of *D. lanceolaria* significantly reduced the swelling of the hind paw of albino rats induced by formaldehyde, although this action was not so potent as that of cortisone or butazolidine (Chaturvedi and Singh, 1964). Out of various extracts of the leaves, only the ethereal, alcoholic and water extracts showed some degree of anti-arthritic effect against formaldehyde-induced chronic arthritis in albino rats (Singh and Chaturvedi, 1966).

A phytogenic principle obtained from *D. lanceolaria* (lanceolarin) showed encouraging result in both carageenin-induced oedema and formalin arthritis in albino rats. The inhibition of oedema was much greater in case of acute inflammation induced the carageenin than formalin-induced inflammation. Preliminary clinical studies were also conducted with the same phytogenic principle on six patients of rheumatoid arthritis in different stages of the disease. A dose of 20 mg. i.m. was given daily for 10 days and encouraging symptomatic improvement was noted in all the patients (Tripathi and Kishore, 1967).

Clinical studies were conducted with the crude drug *D. lanceolaria* on 16 patients of rheumatoid and osteo-arthritis in the form of *avaleha* (a sweet preparation). The drug was given orally in a dose equivalent to 25 g. of wet leaves and tender branches per day. The response to the treatment was encouraging as most of the cases showed clinical improvement (Tripathi and Shukla, 1964).

Further studies were conducted in 24 patients of rheumatoid arthritis of different stages with the crude drug given orally. In early cases, the response to treatment was encouraging, the patients being relieved of pain and swelling within 1-2 weeks of treatment. An improvement in general condition, appetite, anaemia, weight *etc.* was noticed, as also a marked reduction in ESR. In patients having severe disease, some

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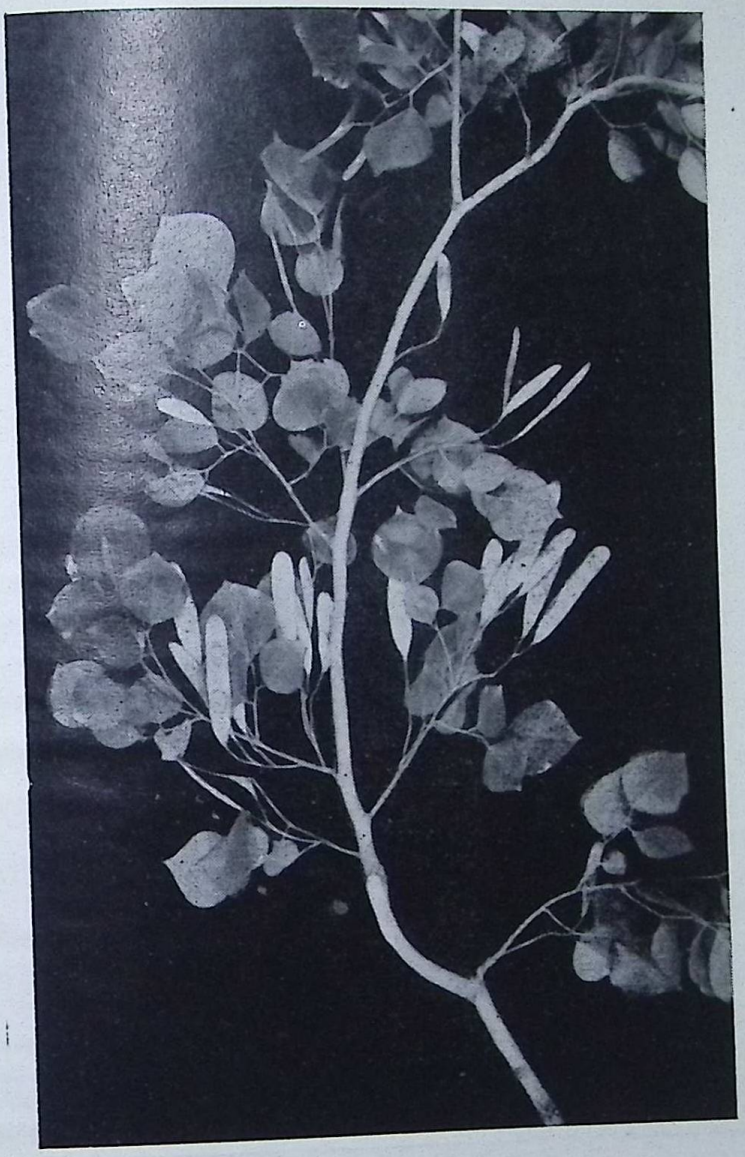

*Dalbergia sissoo*

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*Daphne eleoides*

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improvement could be obtained only after a prolonged therapy, lasting for months but residual signs of joint inflammation persisted (Kishore and Tripathi, 1966).

The alcoholic extract of the stem bark of *D. latifolia* showed anthelmintic activity against *Ascardia galli* (Dhar *et al.*, 1968). The alcoholic extract of the aerial parts of *D. volubilis* showed diuretic activity in albino rats (Bhakuni *et al.*, 1971).

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# DAPHNE (Thymelaeacae)

*D. OLEOIDES* Schreb.

Mar. — Pech Punj. — Mashur

**Habitat :** Grows in western Himalayas at 1000-3000 m, Kanawar, Chamba, Baluchistan and Waziristan.

**Parts used :** Root, bark and leaves.

**Medicinal properties and uses :** Root is purgative. Bark and leaves are used in cutaneous affections. Leaves or their infusion is given in gonorrhoea and applied to abscesses (Nadkarni, 1954; Chopra *et al.*, 1956).

*D. PAPYRACEA* Wall. ex. Steud.

Hind. — Satupra Punj. — Jeku

**Habitat :** Found in temperate Himalayas, from Chamba to Bhutan at 1500-2500 m.

**Parts used :** Root.

**Medicinal properties and uses :** It is a bitter, purgative and febrifuge (Chopra *et al.* 1956).

**Chemistry* :** The powdered leaves of *D. oleoides* were extracted with petroleum ether and the residue separated into acidic and neutral fractions. The acid fraction on further purification yielded stearic acid. The neutral fraction was saponified and the non-saponifiable matter was chromatographed. This yielded β-sitosterol (Das and Mukherji, 1966).

A coumarin glycoside, daphnin, has been isolated from the ethanolic extract of the root of *D. papyracea*. The glycoside, m.p. 225-227°, was hydrolysed by refluxing with 10 per cent methanolic hydrochloric acid for 4 hours. The resulting aglycone, m.p. 225-226° was identified as daphnetin by mixed melting point, its infrared and ultraviolet spectra, and by preparation of its acetate, m.p. 136-137°. The identity of the glycoside was established as daphnetin 7-glycoside methyl ether, m.p. 118-20° (Sharma *et al.*, 1964).

*No report available on other aspects.

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# DATURA (Solanaceae)

*D. ALBA* Nees

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Dhutura | Kon. | — | Dutro |
| Eng. | — | Thorn-apple | Mal. | — | Ummatum |
| Guj | — | Dhatoira | Mar. | — | Dhotari |
| Hind. | — | Sadah-dhatura, safed dhatura, kala dhatura | Punj. | — | Tattur, datura |
| Kan. | — | Ummatty | Tam. | — | Ummatai |
| Kash. | — | Dathir | Tel. | — | Ummatha |

**Habitat :** This plant species has several varieties distinguished by the colour of the flowers as white, purple, *etc.* These grow commonly in waste places throughout India, from Kashmir to Malabar.

**Parts used :** Whole plant, leaves, seeds, roots and fruits,

**Ayurvedic description***

Sanskrit : *Dhattoora*

Synonyms : *Dhoorta, kanaka, dhastoora, unmatta, devika, kitwa, tooree, mahaamohee, shiva, shivapriya, maatula, madana, maatulaputrakam*

Properties : *Rasa* — *Madhura,* (*Kashaaya*)
*Veerya* — *Sheeta*
*Vipaaka* — *Katu*

Actions/Uses : *Madakara, varnaprasaada, agnivardhaka, nidraanahshanee, mootrala, yooka—likshaashamanee, jwaraghna, kushthaaghna, vranahara, kandoo-ghni, vishahara, vedanaashamanee, bhramakara*

*Same for *D. metel* and *D. stramonium* also.

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**Medicinal properties and uses :** The plant has narcotic, anodyne and antispasmodic properties, analogous to those of belladonna. It causes dilatation of the pupil when locally applied as aqueous solution. Dried seeds are thought to be more powerful soporific than the leaves. Vaidyas regard the drug as intoxicant, emetic, digestive, antispasmodic and healing (Nadkarni, 1954).

*D. METEL* Linn.

Ben. and Mar. — Dhatura Tam. — Vellummattai
Hind. — Sada dhatura, kala-dhatura

**Habitat :** Found throughout India. Occasionally grown in gardens.

**Parts used :** Seeds, leaves and roots.

**Medicinal properties and uses :** Seeds, leaves and roots are used in insanity, fever with catarrh and cerebral complications, diarrhoea, skin diseases and as antiseptic. Dried leaves are used in medicine for the same purpose as the leaves of *Belladonna* (Chopra *et al.*, 1956).

*D. STRAMONIUM* Linn.

Ben. — Sada dhuttura Punj. — Tattu dattura

**Habitat :** Grows in Himalayas from Kashmir to Sikkim upto 3000 m., Baluchistan, hilly districts of central and south India.

**Parts used :** Leaves, seeds, fruits and flowers.

**Medicinal properties and uses :** Leaves and seeds are antiseptic, anodyne, narcotic. Fruits are sedative and intoxicating. Leaves are applied to boils, sores and animal bites. Juice of fruits is applied to scalp for curing dandruff and falling hair (Chopra *et al.*, 1956).

**Pharmacognosy :** The anatomical details of leaves of white and black varieties of Indian Datura (*D. metel*) have been described in order to clarify the confusion that exists in the nomenclature of the plants. The distinguishing features of the leaves of the two varieties in powder form have also been indicated for purpose of pharmacognostic identification. The leaves of the black variety are ovate with deeply toothed margins. The petiole, the midrib and the prominent veins of the leaves are purple to deep violet in colour due to the presence of anthocyanin pigment. The surface is apparently glabrous.

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*Datura fastuosa*

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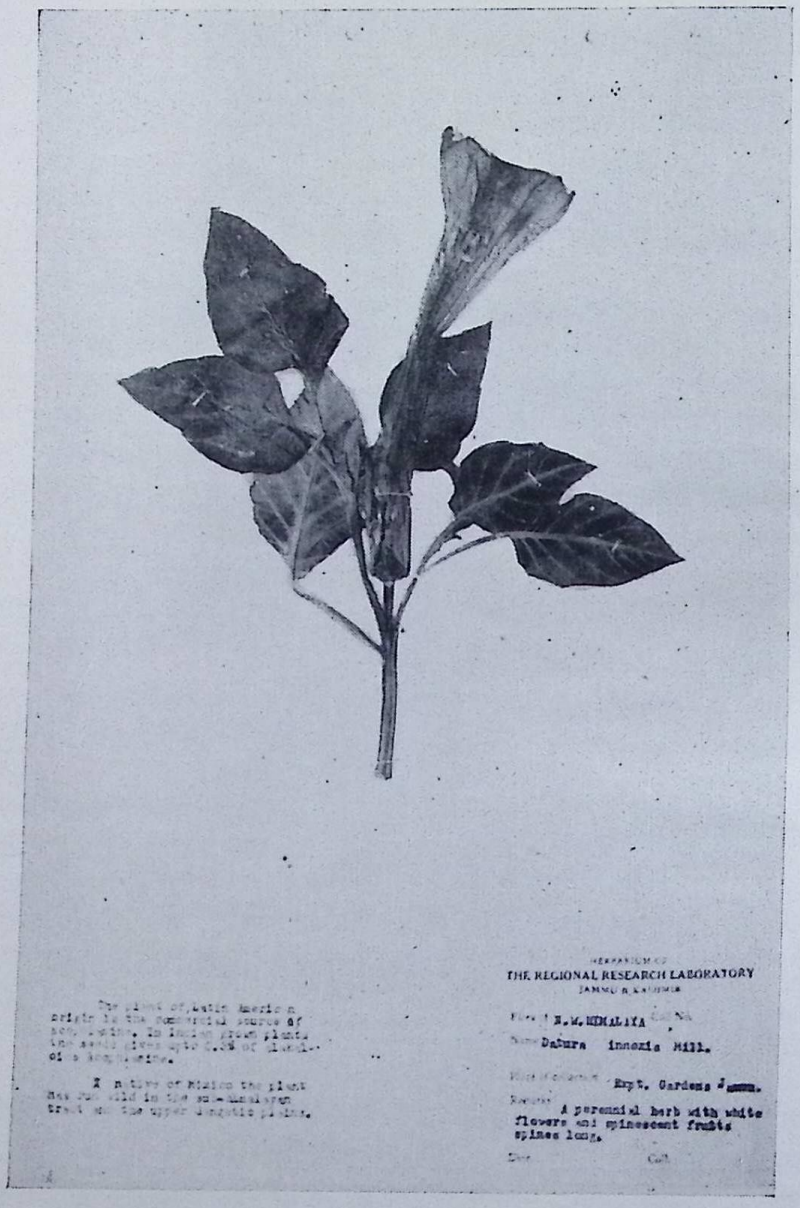


*Datura innoxia*

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In the white variety the margins are more or less entire, and the petioles and prominent veins are light green and the lower surface is velvety.

In the black variety, the hairs are multicellular, with pointed head, warty and short, unicellular stalked, glandular, while in the white variety they are multicellular with wollen head. The stomata of black variety are half constructed, besides the normal, cruciferous ones while that of white variety are cruciferous only.

The pharmacognostic values like vein-islet number, palisade ratio, stomatal index have also been found out (Chaudhury *et al.*, 1953*a*). The anatomical details of the flowers of white and black varieties of Indian Datura have also been described (Chaudhury *et al.*, 1953*b*).

The important morphological and histological differences of the stems and roots are also described. The stem of black variety is purple coloured, woody and smooth, having a few multicellular trichomes, while that of the white variety is greenish, more or less secculent, stout, soft, pubescent and hollow. Large number of multicellular trichomes, together with some unicellular trichomes are present. The roots of the black variety have phloem fibers in groups and vessels arranged in various position. In the other variety phloem fibres are absent or very few in number and the vessels are arranged radially (Chaudhury and Datta, 1955).

The confusion regarding the botanical identity of Indian Daturas has been cleared by describing the morphology and histology of authentic *D. metel* and *D. metel* var. *fastuosa*. Both have nearly glabrous stem and leaves, fragile stem and tubercled fruits. *D. metel* var. *fastuosa* can be distinguished by the purple colour of the stem, main veins, flowers and double or triple corolla and also by the greater number of collapsed stomata and striated cuticle of the lower epidermis of the leaf and by palisade ratio and stomatal index. Older *D. metel* stem is ash coloured, flowers are creamy white with a single carolla (Shah and Khanna 1965*a*).

**Chemistry :** In their general chemistry, the Indian Datura plants fall in line with the very well known and classical solanaceous alkaloidal plants namely *Atropa belladonna*, *Hyoscyamus indicus* and *Datura stramonium*, which are known to contain the therapeutically useful alkaloids hyoscyamine and hyoscine. The Indian Daturas also contain these alkaloids but *D. metel* contains in addition meteolidine which may be considered as characteristic of this species. Considerable work has been done to establish conditions for getting the best yields of the valuable alkaloids hyoscyamine and hyoscine. Cultivation, harvesting and processing have been studied in great detail. Some of the salient results arrived at are mentioned below.

It has been shown that there is no difference in the alkaloidal (hyoscyamine) content of the leaves of *D. metel* dried by different methods, like sun drying (hyoscyamine 0·225-0·258 per cent) shade drying (0·251-0·257 per cent) and oven drying (0·252-0·259 per cent). Also the enzymes present in *D. metel* have no action on the alkaloids during drying (Chaudhury, 1953).

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The roots of *D. metel* (black variety) could be used as a source of the alkaloids. The roots of thinner diameters contain a greater percentage of total alkaloids as compared to thicker ones (Chaudhury *et al.*, 1953*c*). The roots of lowest diameter of *D. metel* have been found to contain maximum percentage of total alkaloids (Datta, 1955).

It has been found that the alkaloid content of the leaves of different sizes of *Datura* is almost constant (Chaudhury, 1954).

Total alkaloids as well as percentages of hyoscine and hyoscyamine have been determined in the leaves, flowers, and herbs of *D. metel* and *D. metel* var. *fastuosa*. The latter was found richer in total alkaloids. Hyoscine and hyoscyamine were present in both the species. Leaves of both species contained more hyoscyamine than hyoscine, while flowers and herbs contained more hyoscine than hyoscyamine. *D. metel* var. *fastuosa* may, therefore, be used for the production of hyoscine and hyoscyamine. It was also found that the total percentage of alkaloids in seeds and pericarps of *D. metel* var. *fastuosa* was more than twice that in *D. metel*. It was evident that the percentage of hyoscine in all the cases was more than that of hyoscyamine. The estimation of the alkaloids in both species has been reported (Shah and Khanna, 1963, 1964).

Hyoscyamine, hyoscine and meteloidine have been found in the leaves, herbs and roots of *D. innoxia*, but only hyoscyamine and hyoscine were present in the flowers, pericarps and seeds. In addition, the roots contained 7-hydroxy-3, 6-di-tigloyloxytropane; (—)-3α, 6 β-di-tigloyloxytropane; tropine and psuedotropine. All the parts of the plant had a higher percentage of hyoscyamine or hyoscyamine-meteloidine mixture than of hyoscine (Shah and Khanna, 1965*b*).

It was found that the aerial parts of *D. metel* var. *fastuosa* contained a higher percentage of total alkaloids than *D. metel* while the roots of both the species contained nearly the same percentage. The roots of *D. metel* contained more hyoscine and less hyoscyamine as compared to *D. metel* var. *fastuosa*. As in *D. innoxia* and *D. ferox*, roots of *D. metel* and *D. metel* var. *fastuosa* contained ditigloyloxytropanes, hyoscine, hyoscyamine, tropine and pseudotropine. Meteloidine was absent in these roots (Shah and Khanna, 1965*c*).

*D. innoxia* plants when treated with gibberellic acid, indole-3-acetic acid and 2 : 4 dichlorophenoxy acetic acid gave better vegetative growth as compared to the untreated plants. The alkaloidal content was more in the leaves and flowering tops of the plants treated with indole-3-acetic acid, indole-3-propionic acid, 2 : 4 dichlorophenoxy acetic acid and gibberellic acid (Sinha and Varma, 1965).

Biogenesis of tropic acid from *D. stramonium* via a novel carbon monoxide insertion reaction has been described (Ghosal, 1965).

The effect of ammonium sulphate, superphosphate, a mixture of ammonium sulphate and superphosphate (1 : 1), pottassium dihydrogen phosphate and potassium nitrate on the growth and alkaloidal content of *D. innoxia* has been studied. Only the plants treated with potassium nitrate yielded a significantly higher dry weight and alkaloidal content per plant as compared to the untreated plants (Sinha and Varma, 1966).

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Hyoscine and hyoscyamine have been found in the leaves, flowers and stems of *D. arborea*. All parts had higher percentage of hyoscine than hyoscyamine and the ratio was approximately 2 : 1. An unidentified alkaloid has been found in chloroform fraction and apohyoscine was found in light petroleum fraction (Shah and Saoji, 1966).

The location of alkaloids in the capsules and seed portions of some *Datura* species has been worked out (Madan *et al.*, 1966).

Gibberellic acid, indole-3-yl-acetic acid and indole-3-yl-propionic acid in a concentration of 100 p.p.m. were given as an aqueous spray to the aerial parts of *D. metel* var *fastuosa*. Different growth responses were obtained by different hormones. The total alkaloidal content of the leaves was more in each of the treated groups. The percentage of alkaloid was more in plants treated with gibberellic acid and indole-3-yl-propionic acid and slightly less in those treated with indole-3-yl-acetic acid. The proportion of hyoscine and hyoscyamine remained the same in each group after treatment (Shah and Saoji, 1967*a*).

From the roots of *D. arborea* (-) -3, 6-ditigloyloxytropane, 7-hydroxy, 3, 6-ditigloyloxytropane, tropine, hyoscine and hyoscyamine were isolated, identified and estimated. The first three bases were reported for the first time. Ammoniacal chloroform eluate alongwith tropine indicated the presence of another base which was presumably pseudotropine (Shah and Saoji, 1967*b*).

Twenty groups of *D. innoxia* plants were treated with a single or double spray of 100 and 1000 p.p.m. of indole-acetic acid in aqueous solution at various stages of growth. The percentage of alkaloids and the dry weight of the leaves and tops increased significantly over the controls in only a few groups. The same pattern was observed in the roots as far as the alkaloidal percentage was concerned, but the dry weight showed a significant increase in five of the treated groups. However, the total alkaloidal content of leaves and tops was found to be significantly more in as many as five of the treated groups and in as many as nine groups in the case of roots. Often it was one of the double spray treatments with 100 p.p.m. of indole acetic acid which gave the best results (Sinha and Varma, 1968, 1970).

Seasonal periodicity in the total alkaloid percentage has been found to occur in *D. metel*. The percentage of total alkaloids produced in each plant varied according to the chromosome set-up of the species. Polyploids showed higher production values than either haploid or diploid species. External factors like altitude influence the alkaloid contents within the same species. These findings could be utilised for commercial exploitation of the alkaloids (Karnick and Saxena, 1970*a*).

The effect of virus infection on active principles of *D. innoxia* has been reported. The alkaloid content of the diseased leaves was higher than that of the healthy leaves. The alkaloidal content of seeds from diseased plants was also higher than that of healthy plants (Singh and Khan, 1970).

Seeds from a single plant were treated with 0·4, 0·6, 0·8 and 1·0 per cent of aqueous solution of colchicine for 48 hours. Treatment with 0·8 per cent gave the best results.

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Thirty-one out of fifty seedlings were tetraploid. They had larger stomata and pollen grains as well as larger leaves and flowers than the diploids. Chemical analysis of the dry leaves of the diploid showed 0·1-0·2 per cent total alkaloids. The range of variation in alkaloid content shown by the population indicated that possibly a number of genes were responsible for the production of alkaloids (Ammal and Zutshi, 1970).

Feasibility of utilizing various *Datura* species occurring as weed in the sub-Himalayan tract of Jammu and Kangra, for the production of hyoscine has been investigated. *D. innoxia* (seeds) and *D. metel* (seeds and leaves) can be economically exploited for this purpose (Prabhakar, *et al.*, 1971).

Unorganised static tissue culture of *D. metel* maintained for 32 months showed the presence of atropine, choline and hyoscyamine along with other five unidentified alkaloids. On transfer to singly supplemented phenylamine and tyrosine media, the tissues showed considerable increase in alkaloid contents in both the instances. Only atropine was confirmed along with other three unidentified alkaloids in tissues grown on amino acid supplemented media (Khanna and Nag, 1972).

Various aspects of study on *Datura* species has been discussed in a review article (Karnick and Saxena 1970*b*).

**Pharmacology :** The alcoholic extract of the entire plant *D. metel* showed anthelmintic activity against *Ascardia galli*. It also possessed anti-cancer activity against human epidermal carcinoma of the nasopharynx in tissue culture. The alcoholic extract of the entire plant *D. quercifolia* showed hypoglycaemic activity in albino rats. The alcoholic extract of the fruits of the same plant showed anthelmintic activity against *Ascardia galli*. (Dhar *et al.*, 1968).

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*Datura stramonium*

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*Daucus carota*

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# DAUCUS (Umbelliferae)

*D. GAROTA* Linn.

| | | | | | |
|---|---|---|---|---|---|
| Eng. | — | Carrot | Kash. | — | Mormuj |
| Hind., Mar., | | | Tam. | — | Gajjara-kilangu, kerat |
| Guj. and Ben. | — | Gajar | Tel. | — | Pita-kande |
| Kan. | — | Gajjari | | | |

**Habitat :** Indigenous to Kashmir and western Himalayas, now largely cultivated in India for culinary purposes.

**Parts used :** Root and seeds.

**Ayurvedic description**

Sanskrit : *Garjara*

Synonyms : *Gajara, naarangavarnaka, gunjanaka, marjara, aarangaka, varnaka, raktakanda, swaadumoola, peetaka, grunjana*

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| Properties : | *Rasa* | — | *Maduhra, kashaaya, tikta* |
| | *Guna* | — | *Laghu, teekshna, vidaahee* |
| | *Veerya* | — | *Ushna* |
| | *Vipaaka* | — | *Madhura* |
| Actions/Uses : | General | — | *Sangraahee, deepanee, hridya, vrishya, grahaneera-gashamanee, arshoghna, drukprasaadakara* |
| | Seeds | — | *Ushna, graahee, vrishya, garbhapaatakara, jantughna* |

**Medicinal properties and uses :** Carrot has a beneficial influence on the kidneys and dropsy and prevents the brick-dust sediment sometimes found in the urine. As antiseptic it prevents putrescent changes within the body. Seeds are used as aphrodisiac and nervine tonic. Carrots cleanse the blood. Seeds are aromatic, stimulant and carminative (Nadkarni, 1954).

**Chemistry :** The seeds of *D. carota* contained fixed oil as well as volatile oil. The water soluble fraction of the alcoholic extract contained some glycosidal principle (Agarwal *et al.*, 1953).

Two quaternary bases have been isolated from the water soluble fraction of alcoholic extract of seeds of *D. carota* (Gambhir *et al.*, 1966*a*).

**Pharmacology :** The alcoholic and aqueous extracts of the seeds showed encouraging antifertility activity by preventing implantation in 66·6 per cent and 60 per cent rats

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respectively. These extracts also exerted some abortifacient activity (Garg and Garg 1970). The chloroform fraction of the petroleum ether extracts of the seeds was found to have encouraging antifertility activity in femule albino rats (Dhar *et al.*, 1973). Various chromatographic fractions of the petroleum-ether, alcoholic and aqueous extracts were studied for their antifertility activity. The chloroform and methanol fractions of petroleum ether extract; chloroform—methanol (9:1 v/v) fractions of the alcoholic extract and chloroform and ethyl acetate fractions of the aqueous extract showed 80 to 100 per cent inhibition of implantation in rats (Garg, 1973). Studies on anti-progestational activity revealed that the aqueous extract of the drug suppressed the formation of deciduoma and the suppression was found to be dose-dependant (Garg *et al.*, 1973).

The aqueous extract besides having anti-fertility activity was found to possess anti-estrogenic, anti-progestation, anti-histaminic and anti-acetylcholine activity. It also raised the blood pressure in anaesthetised dogs and increased the force of myocardial contraction in isolated rabbit heart (Gupta *et al.*, 1972).

The water soluble fraction of the alcoholic extract of the seeds was found to have marked transient hypotensive effect in anaesthetized dogs which was due to direct depression of vasomotor centre, myocardium and smooth muscle of the blood vessels. The extract caused slowing with diminished tone of contraction in isolated heart as well as *in situ*. It was found to depress the respiration. It relaxed the smooth muscles of the intestines and non-pregnant uterus of rats and rabbits (Agarwal *et al.*, 1953). The extract showed spasmodic action on the smooth muscles of the isolated ileum and trachea and on frog's rectus abdominis muscle. The action was not significantly modified by prior treatment with ganglionic blocking agent. However, its action on isolated smooth muscles and skeletal muscle was completely blocked by pretreatment with atropine and tubocurarine, respectively. In the ileum, the drug produced relaxation after atropinization. These studies revealed the presence of cholinergic and papaverine-like active principles and probably also a cardiotonic principle(Gambhir *et al.*, 1966*a*).

A quaternary base identified as choline chloride has been shown to possess cholinergic activity (Gambhir *et al.*, 1966*b*). A tertiary base isolated from the extract was found to possess relaxant action on isolated smooth muscles of ileum and uterus of different animals. It had nonspecific antispasmodic activity against drug-induced spasms in ileum, uterus and tracheal smooth muscle. The compound was found to be 10-15 times less potent than papaverine hydrochloride (Gambhir *et al.*, 1968).

The essential oil obtained from the seeds produced a transient fall of arterial blood pressure in anaesthetized dog without affecting the respiration in lower doses. At a higher dose, it produced a persistent hypotension and also caused depression of respiration. The oil exerted a direct cardiac depressant action on frog heart and dog heart in the open chest preparation. It also showed marked CNS depressant action in rats and fish. It afforded moderate protection to frogs from the convulsant effect of strychnine and metrazol. A relaxant effect was observed in isolated intestine of rat and rabbit and isolated uterus of rat (Bhargava *et al.*, 1967).

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# DELONIX (Leguminosae)

*D. REGIA* Raf. (Syn. *Poinciana regia* Bojer ex. Hook).

| | | | | | |
|---|---|---|---|---|---|
| Eng. | — | Flamboyant, Flame tree, | Tam. | — | Mayarum |
| Hind. | — | Gul mohur | Tel. | — | Shima sankesula |

**Habitat :** A strikingly ornamental medium sized tree, planted in avenues and gardens in all the warmer and damper parts of India. It has a spreading crown of feathery foliage and bears flowers early in the hot season.

**Parts used :** Flowers.

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**Medicinal properties and uses :** Flowers are used as anthelmintic.

**Chemistry*** : The deep red colour of the flowers has been found to be due to the presence of cyanidin diglycoside (Ponniah and Seshadri, 1953).

Lupeol and β-sitosterol were isolated from the alcoholic extract of the bark of *D. regia* (Roy and Sengupta, 1968).

The petroleum ether extract of the flowers yielded hentriacontane, β-sitosterol and hentriacontanol. The ether extract gave β-D-glucoside of β-sitosterol, protocatechuic acid and quercetin (Gupta and Chandra, 1971).

A galactomannan, composed of D-galactose (1 mol.) and D-mannose (2 mols.) was isolated from the seeds of *D. regia*. It has been established that the galactomannan is a highly branched polysaccharide consisting of a main chain of mannose linked through β-(1-4) and a side chain of single galactose units linked through α (1-6) (Kapoor, 1972).

Examination of the bark of *D. elata* for crystalline components using solvents of increasing polarity on succession yielded β-amyrin from the petroleum ether extract, sitosterol and its D-glucoside from the ether extract, and sucrose from the alcohol extract (Hariharan, 1969).

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## DENDROBIUM (Orchideae)

*D. MACRAEI* Lindl.

Ben. — Jebai
Hind. — Jaivanti
Mar. and Sans. — Jivanti

*No report available on other aspects.

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**Habitat :** A much branched plant often found in Sikkim, Khasia hills, Konkan, Nilgiris and also common on hills of south India.

**Parts used :** Whole plant, root and stem.

**Medicinal properties and uses :** The whole plant is cooling, mucilaginous, light, strengthening, demulcent and tonic, given in debility due to seminal discharges. The whole plant is used as decoction along with other drugs having similar properties. Used also in snake bite (Nadkarni, 1954).

**Pharmacology* :** A chemical fraction obtained from the plant was found to lower the blood pressure in acute and chronic hypertension induced by noradrenaline infusion in anaesthetized cats and dogs and by deoxycorticosterone acetate i.m. in rabbits. In acute toxicity studies in mice, $LD_{50}$ was found to be 137 mg./kg. i.v., whereas in subacute toxicity studies in rats and dogs, the compound showed evidence of hepatotoxicity (Mukherjee *et al.*, 1973).

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## DERRIS (Papilionaceae)

*D. SCANDENS* Benth.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Noaalata | Tam. | — | Takil |
| Punj. | — | Gunj | Tel. | — | Nalatige |

**Habitat** : Grows wild in south India.

**Parts used :** Bark.

**Medicinal properties and uses :** Bark is a cholagogue and used as a fish-poison. It is also used in snake-bite (Nadkarni, 1954).

*No report available on other aspects.

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*D. ULIGINOSA* Benth.

Ben. — Panlata Mar. — Kajarvel

**Habitat :** Grows in eastern Himalayas, western Peninsula and Ceylon.

**Parts used :** Root bark.

**Medicinal properties and uses :** It is used as an alterative and insecticide. It is also employed as a fish poison (Nadkarni, 1954).

**Chemistry* :** The roots of *Derris scandens* from Chanda district in Maharashtra gave scandenin as the main component and chandanin and nallanin as minor components. They belong to a new type of coumarins called 3-phenyl-4-hydroxy coumarins with isoprene units attached in various positions (Rao and Seshadri, 1946). The aerial parts of *D. scandens* yielded lupeol, taraxerol and β-sitosterol (Sengupta *et al.*, 1971).

Samples of *D. uliginosa* were collected from their natural surroundings from the Sundarbans area throughout the year to study the seasonal variations on the rotenone content in different plant parts. The roots showed the highest percentage of rotenone during November-February. The relationship between the exogenous factors and rotenone content has been studied (Nandy and Gupta, 1968).

### References

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Sengupta, P., Das, P.S. and Saha, S.K. 1971. Triterpenes from *Derris scandens* (Roxb.) Benth. **J Indian Chem Soc 48,** 95.

## DESMODIUM (Papilionaceae)

*D. GANGETICUM DC.* (Syn. *Hedysarum gangeticum* Linn.)

Ben. — Salpani
Hind. — Sarivan
Kan. — Shaliparni
Mar., Kon and Guj — Salvan
Tam. — Pullaadi
Tel. — Gitanaram

* No report available on other aspects.

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**Habitat :** Grows wild in lower Himalayan regions and throughout the plains of India.

**Parts used :** Whole plant, root and bark.

**Ayurvedic description**

Sanskrit : *Shaalaparna, Shaalaparni*

Synonyms : *Sthira, vidaarigandha, atiguha, saumya, deerghamoolika, amshumati, guha, triparni, mahaakleetaanika, aakuparnikaa, parninee, atiruha, dhruva, peethanee*

Properties : *Rasa* — *Madhura, tikta*
*Guna* — *Guru, snigdha ?*
*Veerya* — *Ushna*
*Vipaaka* — *Madhura*

Actions/Uses : *Snehana, stambhana, hridya, krimighna, shothahara, vrishya, mootrala, vishamajwaraghna, mehaghna, shoshahara, trishnaghna, garavishahara, chardighna, shwaasahara, ateesaaraghna, brihmana, rasaayana, angamardaprashamana, kshataghna*

**Medicinal properties and uses :** It is a bitter tonic, febrifuge, digestive, anticatarrhal, alterative and tonic (Nadkarni, 1954). The root of *D. gangeticum* is one of the ingredients of a famous Ayurvedic preparation *Dashamoola kwaatha,* which is considered to be antipyretic, alterative and a bitter tonic. It is reported to be beneficial in the treatment of typhoid, billiousness and also as diuretic and aphrodisiac.

**Pharmacognosy :** Macro and microscopic characters of the roots of *D. gangeticum* have been studied. Commercially, the root is found in cut pieces and mixed with short stem. The root system consists of poorly developed tap root, which is smooth externally. It bears a number of transverse lenticels and nodules. The bark is thin, loosely adhering to the wood in the centre. The primary structure of the root is tri to tetrarch, the former being more common. The primary phloem shows the formation of phloem fibres; phellogen formation takes place in the pericycle. The mature root consists of 3-7 layers of tangentially elongated cork cells, and a wide zone of secondary phloem encircling the xylem showing one or rarely two growth rings. Fibres are present in groups in phelloderm and phloem region. Phloem rays, 1-3 cells wide are more common. The xylem has a diffuse porous arrangement of xylem vessels. Pith is absent. Crystal sheaths are found both in phloem and xylem regions. Prismatic crystals of calcium oxalate, starch grains, resin as granular mass besides alkaloids, sterols, tannins and reducing sugar, were found in almost all the

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parenchymatous tissue of the root. Root powder, when treated with sodium hydroxide in methanol and mounted in nitrocellulose, exhibited light brown fluorescence (Prasad and Ansari, 1966-1967).

The detailed pharmacognostic characters of the root have also been worked out. The root shows a normal dicotyledonous structure. A few characteristic lignified fibre patches are found in the cortex and xylem region which occur singly or in groups. Some of the parenchyma cells of the cortex contain rectangular crystals of calcium oxalate. Simple starch granules are present in the wood parenchyma. The ash values and crude-fibre have been determined and fluorescence analysis has also been carried out (Mehra and Raina, 1969).

**Chemistry :** Preliminary phytochemical studies were carried out with the various extractives obtained by repeated extractions of the powdered root drug with different solvents. Sterols were found to be present in petroleum ether and solvent ether extracts, whereas alkaloids were present in the alcohol extract. Paper and thin layer chromatographic studies of the alcoholic extract have been carried out to find out the number of alkaloids present (Mehra and Raina, 1969).

The aerial portions of the plant contained two previously known indole-3-alkylamines and their Nb-oxides, Nb-methyltetrahydroharman and 6-methoxy-2-methyl-β-carboline. Air dried samples of this plant contained 0·01—0·03 per cent total alkaloid but fresh plant materials had more than three times the amount present in dry and preserved plants. In addition, fresh plant materials showed a large number of uncharacterised indoles and 5-oxyindoles of low Rf values. Chemical proof for the structure of the quaternary compound was obtained from the method of its isolation and its reduction with sodium and ethanol to 6-methoxy-2-methyl-1, 2, 3, 4-tetrahydro-β-carboline (Ghosal and Banerjee, 1968).

The leaves of *D. trifolium* contained β-phenethylamine, tyramine, trigonelline, hypaphorine, choline and betaine. The major alkaloid of the root was hypaphorine (Ghosal *et al.*, 1971).

A new glycoside 1-glucosylrhamnoside of physicion was identified in the seeds of *D. pulchellum* (Tiwari and Bansal, 1971).

**Pharmacology :** The aqueous extract of the root of *D. gangeticum* exhibited anti-inflammatory, antibacterial and anti-fungal activities. The drug showed inhibitory effect on the isolated frog's heart. It had a relaxant effect on the smooth muscles of intestines of rabbit and dog and on the isolated rat uterus. The drug had mild diuretic effect and it inhibited respiration in moderate doses. It was found to be nontoxic in acute toxicity studies (Prema, 1968).

The total alkaloid fraction of stem and leaves of *D. gangeticum* and total alkaloids of roots of *D. pulchellum* exhibited curariform activity on frog's rectus muscle (Bhattacharya and Sanyal, 1969).

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Quarternary aromatic β-carbolines isolated from *Desmodium* sps. were found to be about one-sixth, as potent as physostigmine as cholinesterase inhibitors. The inhibitory potencies were nearly the same against acetylcholinesterase and pseudo-cholinesterase. The tertiary β-carbolines showed only weak activity (Ghosal *et al.*, 1972).

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# DIDYMOCARPUS (Gesneriaceae)

*D. PEDICELLATA* R. Br.

Hind. — Pathar phori

**Habitat :** Grows in sub-tropical western Himalayas from Chamba to Kumaon at 1000-2000 m.

**Parts used :** Leaves.

**Medicinal properties and uses :** Leaves are used as a cure for stones in kidneys and bladder (Chopra *et al.*, 1956).

**Pharmacognosy :** Detailed macroscopical, anatomical and sensory characters of the rhizomes and leaves have been studied. The volatile oil is present in the parenchyma-

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*Desmodium gangeticum*

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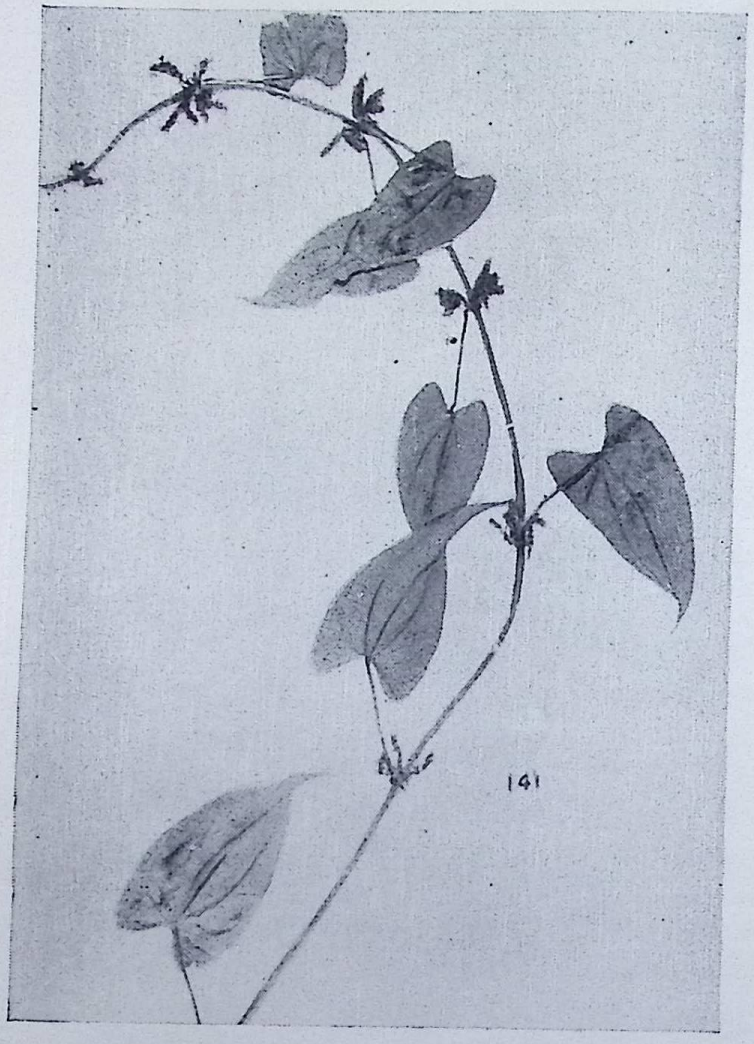


*Dioscorea alata*

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tous cells of the drug and also in the glandular hairs present on the surface of the rhizome and on the leaf. The hairs have unicellular stalk and 4-7 celled head. The leaves showed the presence of flavones. Ash and extractive values are also reported. The fluorescence analysis of the different solvent extracts under UV light was also done (Shah—Personal communication).

**Chemistry** : Isolation and constitution of pedicellic acid from the leaves has been reported earlier. Pedicellic acid calculated for $C_{18}H_{34}O_4$, had m.p. 92-93° and was found to be a long chain aliphatic acid without unsaturation. Pedicellic acid has been converted into corresponding hydrocarbon called pedicellan (Rao *et al.*, 1966).

Detailed chemical investigation of the plant revealed the presence of related phenolic compounds which were isolated and characterised *viz.* pedicellin, pedicin, isopedicin, pedicinin and methyl pedicin. Pedicellin was isolated as colourless needles, m.p. 98°, $C_{10}H_{22}O_6$, a member of the (fully methylated) chalkone group. Pedicine was also a chalkone, but was coloured and had two hydroxy groups; m.p. 145°, $C_{18}H_{18}O_6$. Isopedicine had m.p. 105°, and was isolated as colourless prismatic needles. It is an isomer of pedicin, 6-hydroxy 5, 7, 8-trimethoxy flavanone. Pedicinin crystalised as dark red flat needles, m.p. 203°, $C_{16}H_{12}O_6$ and was found to be 2, 5-hydroxy-4-methoxy-3, 6-quinochalkone, whereas methyl pedicinin had m.p. 110°. Besides these, a fatty acid named as pedicellic acid was isolated and its constitution established. The yield of the total components, like the proportion of the individual once, varied considerably but was usually about 30 per cent of the weight of dried leaves. Pedicin and pedicillin were major components, while pedicinin and methyl pedicinin were obtained in smaller amounts. All these compounds have been synthesised. The yield of pedicellic acid was about 1 per cent of the air dried leaves (Bahl and Seshadri, 1970).

The roots of *D. pedicellata* have yielded three chalkones besides β-sitosterol. Two of them, pedicine and pedicellin, had been earlier isolated from the leaves of same plant. The third chalkone is new and has been designated as pashanone. Its structure has been established as 2′, 6-dihydroxy-4′-5′-dimethoxychalkone (Agarwal *et al.*, 1973).

From the leaves of *D. pedicellata*, besides pedicin and pedicellin, two new compounds pashanone and methlypedicin have been obtained. The isolation of the latter from a natural source is reported for the first time and this is a major component in the leaves (Bhaskar and Seshadri, 1973). Synthesis of pashanone and its isomers has also been carried out (Bhaskar and Seshadri, 1974).

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## DIGITALIS (Scrophulariaceae)

*D. LANATA* Ehrh.

Eng. — Woolly foxglove

**Habitat :** Grows in north-western Himalayas. It is now cultivated in Kashmir.

**Parts used :** Leaves.

**Medicinal properties and uses :** Leaves are used for certain conditions of heart mainly as a cardiac stimulant and tonic (Chopra *et al.*, 1956).

*D. PURPUREA* Linn.

Eng. — Common foxglove

**Habitat :** Cultivated in Jammu and Kashmir at 2000-2300 m., Darjeeling district and in the Nilgiris.

**Parts used :** Leaves.

**Medicinal properties and uses :** Same as for *D. lanata*.

**Pharmacognosy :** Special types of stomatal thickenings were observed in the epidermis of eleven species of *Digitalis*. The pattern of thickening differed to a certain extent in different species. These thickenings appeared to be similar to those observed in the walls of the epidermis and were cutaneous in character (Singh and Kundu, 1962).

A new variety of *D. purpurea* growing wild in various pockets in the Kodaikanal hills of the Palani Ranges in south India resembles the macroscopical description

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of *D. purpurea*. It has been tentatively named as variety *Venkateswara* based on the histological characters (Venkatappiah, 1969).

**Chemistry :** The most important chemical components of Digitalis leaves, both *D. purpurea* and *D. lanata*, are the cardiac glycosides to which they owe their therapeutic effects. The principal genins are the cardenolides digitoxigenin, gitoxigenin and digoxigenin and the sugars are D-digitoxose, D-digitalose and D-glucose. The genins and sugars occur in a variety of combinations, each with its own physiological properties which explains the variable nature of the pharmacological and the therapeutic effects of the whole leaf obtained from different localities, seasons *etc.*

From a chemical examination of the pigments isolated from the leaves of *D. lanata*, two fractions were obtained which were yellow in colour and gave colour reactions for anthoxanthins. Fraction I could not be completely purified; however, fractional crystallisation yielded two pure entities, scutellarein (5 : 6 : 7:4-tetrahydroxy flavone) and luteolin (5:6:3:4-tetrahydroxy flavone). Fraction I after purification yielded a compound having m.p. 274-76°, $C_{26}H_{12}O_6$. The pigment seemed to be a monomethyl ether of scutellarein not described so far, and designated as dinatin. The structure for dinatin indicated as 4-0-methyl scuteliarein agreed with the observation that it gave a positive Bargellini test which is characteristic of flavones and flavonols having hydroxy groups in 5:6:7-positions (Rangaswami and Rao, 1961). Later, Bhardwaj *et al.*, (1966) carried out synthetic studies which led to the revision of its composition as 6-0-methyl scutellarein.

Seeds of *Digitalis* were found useful for the extraction of glycosides (Shah 1966). Places where *D. lanata* and *D. purpurea* have been successfully grown in India have been recorded (Shah and Sen, 1966).

Gibberellic acid (100 p.p.m.) decreased the surface area and dry weight in *D. purpurea* and doses of 10 and 50 p.p.m. increased the height and dry weight in case of *D. lanata* (Shah and Srivastava, 1967).

The effect of trace elements *e.g.*—copper, boron, zinc and manganese in two concentrations of each 2 and 4 p.p.m. with a set of control replicated three times, on the number of leaves, fresh dry weight and percentage yield (dry matter) in *D. lanata* has been described (Shah and Srivastava, 1968).

**Pharmacology :** The effect of digoxin on cardiac centres was studied in anaesthetized dogs. It was observed that digoxin slowed the heart by an action on the medulla. It seemed to block all the incoming influences to the vagal nucleus including the supramedullary inhibitory influences. The tachycardia appeared to be due to stimulation of the hypothalamic cardio-accelator centre (Bhargava and Gupta, 1962).

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## DILLENIA (Dilleniaceae)

*D. INDICA* Linn. (Syn. *D. speciosa* Griff.)

| | | | | | |
|---|---|---|---|---|---|
| Ben. and Hind. | — | Chalta | Mar. | — | Karambel |
| Kan. | — | Bettakanagale | Tam. | — | Oovamaram |
| Kon. | — | Kadukanagala | Tel. | — | Pedda Kalinga |

**Habitat :** A tree found in tropical forests in the western Peninsula, Bihar and in the Himalayas from Nepal to Assam, and from Sylhet to Ceylon.

**Parts used :** Fruit, bark and leaves.

**Ayurvedic description**

Sanskrit : *Bhavya*

Synonyms : *Karambala karaamla*

Properties : *Rasa* — *Madhura, amla, kashaaya*
*Guna* — *Guru*
*Veerya* — *Sheeta*
*Vipaaka* — *Amla*

Actions/Uses : *Rochani, graahi, vishtambhi, mukhashodhani, hridya, jwaraghna*

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**Medicinal properties and uses :** Juice of the fruit mixed with sugar and water is used as a cooling beverage in fevers and as cough mixture. Bark and leaves are astringent. Fruit is slightly laxative and acidic but is apt to induce diarrhoea, if too freely used (Nadkarni, 1954).

**Pharmacognosy :** The diagnostic characters of the stem bark are lignified stone cells present in the cortex, mucilaginous and tanniniferous cells in the phloem and medullary ray cells, non-lignified phloem fibres and acicular cortical and phloem parenchyma cells. The stem bark is also characterised by the presence of sandy crystals of calcium oxalate in some cortical cells (Chaudhuri, 1968).

**Pharmacology :** The alcoholic extract of the leaves of *D. indica* possessed CNS depressant activity in mice (Bhakuni *et al.*, 1969).

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## DIOSCOREA (Dioscoreaceae)

*D. ALATA* Linn. (Syn. : *D. atropurpurea* Roxb., *D. globosa* Roxb., *D. purpurea* Roxb., *D. rubella* Roxb.).

| | | | | | |
|---|---|---|---|---|---|
| Eng. | — | Yam | Sans. | — | Pindalu |
| Hind and Ben. | — | Chupri alu | Tam. | — | Kodikizangu |
| Mar. | — | Chopri alu | Tel. | — | Pendalamu |

**Habitat :** Cultivated practically all over India.

**Parts used :** Tubers.

**Medicinal properties and uses :** Tubers are anthelmintic, and useful in leprosy, piles and gonorrhoea (Chopra *et al.*, 1956).

*D. BULBIFERA* Linn. (Syn. *D. crispata* Roxb., *D. pulchella* Rev., *D. sativa* Thunb. *D. versicolor* Buch.-Ham ex Wall).

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Banalu | Tam. | — | Kodikilangu |
| Hind. | — | Ratalu | Tel. | — | Chedupaddu-dumpa |
| Mar. | — | Karukarinda | | | |

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**Habitat :** Common throughout India ascending up to 2000 m in the Himalayas.

**Parts used :** Tubers.

**Medicinal properties and uses :** Tubers are used in piles, dysentery, syphilis and applied to ulcers (Chopra *et al.*, 1956).

*D. DELTOIDEA* Wall.

Kash. — Kins, kildri Punj. — Kniss

**Habitat :** Grows in north-western Himalayas from Kashmir and Punjab eastward to Nepal and China at 1000-3500 m.

**Parts used :** Tubers.

**Medicinal properties and uses :** The plant is used for the extraction of diosgenin.

*D. HISPIDA* Dennst. (Syn. *D. daemona* Roxb., *D. hirsuta* Dennst., *D. triphylla* Linn.)

Hind. — Karukandu Tam. — Peiperendai
Mar. — Baichandi Tel. — Tella-ginigeddalu

**Habitat :** Grows nearly throughout India, upto 1400 m. in Sikkim, Hamalayas and is rarely cultivated.

**Parts used :** Milky juice of tubers.

**Medicinal properties and uses :** Milky juice of tubers along with juice of *Antiaris toxicaria* is used as arrow poison.

*D. PRAZERI* Prain and Burkil (Syn. *D. clarkei* Prain and Burkil).

**Habitat :** Wildly grows in moist parts of eastern Himalayas up to 1600 m in north Bihar, north Bengal, Nepal, Sikkim, Bhutan and Abor Hills, and in Naga hills up to 2000 m.

**Parts used :** Tubers.

**Medicinal properties and uses :** Tubers are used to kill lice, and as a fish poison (Chopra *et al.*, 1956). The plant is used for the extraction of diosgenin.

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**Pharmacognosy :** A study of the rhizome of *D. deltoidea* showed a few layers of cork, beneath which is the thin walled cortical parenchyma. Endodermis and pericycle are indistinguishable. The stele is broad forming the main body of the rhizome with partially lignified cells containing many starch grains. Numerous close collateral fibro-vascular bundles are scattered throughout this region. The epidermis of the rhizome is mostly detached and broken and seldom seen in a cross section. The powder foams with water indicating the presence of saponins. The plant is used as a source of raw material for the synthesis of cortisone and sex hormones (Abrol *et al.*, 1962).

Five species of *Dioscorea* occurring in Madhya Pradesh *viz*, *D. alata*, *D. bulbifera*, *D. pentaphylla*, *D. oppositifolia* and *D. bulophylla* have been described. The nature of their tubers, variation in leaves, epidermal patterns, number of bulbils produced by each species, and the structure of epidermal hairs have been studied along with their fruiting and flowering time. A key based on their comparative morphology has been given (Karnick 1966*a*).

The tubers of *D. alata* and *D. hispida* arise from the ventral ridge between the first shoot and the true root of the seedling. This ridge or bulge is due to meristematic activity of the ground meristem. Primary growth of the tuber was observed to take place by multiplication and thickening of primary meristem at the apex. The tissue of the tuber arises from ground meristem and from storage parenchyma enclosed groups of xylem and phloem, parenchymatous cortex which contains a well defined cambium layer. A true periderm exists but transitorily. The placement of tuber in soil is horizontal in the case of *D. alata*. It has a dorsiventral orientation. The dorsal surface gives rise to new aerial shoots, whereas the ventral produces new adventitious roots. *D. hispida* has bulbous round tuber. Growth of the tuber is more pronounced on the dorsal side in *D. alata*, and on dorsiventral side in *D. hispida*. The anatomy of the tuber is closely similar to that of the stem rather than the root. The starch is concentrated in the older tissues of the tuber (Karnick 1966*b*).

**Chemistry :** A method based on gravimetric principle has been developed for the assay of diosgenin content of the yams (Chakravarti and Dash 1957).

An assay method has been developed for estimation of diosgenin content of *Dioscorea* species, which involves hydrolysis of a weighed amount of the dry powdered specimen with five per cent aqueous hydrochloric acid. The sapogenin thus obtained on chromatographic purification gives diosgenin (Chakravarti *et al.*, 1970).

With regard to the utilisation of Indian yams for the preparation of steroid hormones, isomerisation was studied critically for simplification in the procedure and any improvement in the yield. The results of the study showed that optimum condition for the conversion is a temperature of 192°, the period of heating being ten hours (Chakravarti *et al.*, 1957).

A simplified procedure for the preparation of pseudosapogenins has been described which constitutes the first step in the preparation of progesterone, cortisone *etc.* from

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steroid sapogenins. This is of considerable significance for the large scale preparation of these steroidal hormones, as under the modified conditions there is no need to carry out the reaction in a strongly heated autoclave. In addition, a much less quantity of acetic anhydride is necessary to compensate for the cost involved in the use of triacetin (Chakravarti *et al.*, 1958).

The effect of saponase on *Dioscorea* has been studied by using fresh *Agave cantala* leaves and powdered *D. prazeri* and *D. deltoidea*. On crystallisation from alcohol, two products were obtained : product A, m.p. 203-204°, yield 2·8 per cent and product B, m.p. 180°, yield 2·6 per cent, from *D. prazeri* and *D. deltoidea* respectively. Product A on chromatography gave disgenin m.p. 202-203° and epi-smilagenin m.p. 212-214° whereas, product B on chromatography gave diosgenin and smilagenone m.p. 188-189° (Chakravarti *et al.*, 1960*a*). The Indian sources of diosgenin with greater yield are *D. deltoidea* of Kashmir containing 4-5 per cent of diosgenin and *D. prazeri* of Darjeeling containing 2-3 per cent diosgenin. Another species from which disgenin has been isolated is *D. glauca* which contains 4-4·5 per cent of diosgenin. After crystallisation from alcohol, the product melted at 198-202° (Chakravarti and Dash 1960).

Epismilagenin has been obtained by catalytic reduction of smilagenone. Earlier, *Smilax osnata* was the only source for smilagenin. Now new methods have been devised for the preparation of smilagenone and epismilagenin from *D. prazeri* and *D. deltoidea* (Chakravarti *et al.*, 1960*b*).

A reliable method for the isolation of saponins from *Dioscorea* yams as well as *D. glauca* has been developed. The yield of crystalline saponin by this method was 2 per cent, 4 per cent and 5 per cent respectively from *D. prazeri*, *D. glauca* and *D. deltoidea*. The crystalline saponins were insoluble in propylene glycol whereas *D. deltoidea* saponin was insoluble in the usual solvent (Chakravarti *et al.*, 1961).

The diosgenin content of the yams of the same species of *Dioscorea* grown under different conditions has been investigated. Yams of *D. deltoidea* were the richest source of diosgenin in India. But further investigations have shown that the diosgenin content varies in different species (Chakravarti and Dash, 1966).

*D. deltoidea* and *D. prazeri* from different localities of India were grown in cultures. They yielded varying percentages of sapogenin at various stages of growth. Sapogenin concentration increased with the age of tuber. The optimum sapogenin content was found when the plants were first shedding their leaves (Karnick, 1968).

The effect of keeping Indian *Dioscorea* yams (*D. deltoidea*) under water for a prolonged period on the nature of hydrolytic products and the effect of hydrolysing the saponins of *Dioscorea sps* with saponases from *Agave* leaves have been studied (Chakravarti *et al.*, 1968).

A novel norditerpene lactone, diosbulbine, has been isolated from the tubers of *D. bulbifera*. Diosbulbine, m.p. 295°, analysed for $C_{19}H_{20}O_6$ showed dimorphic

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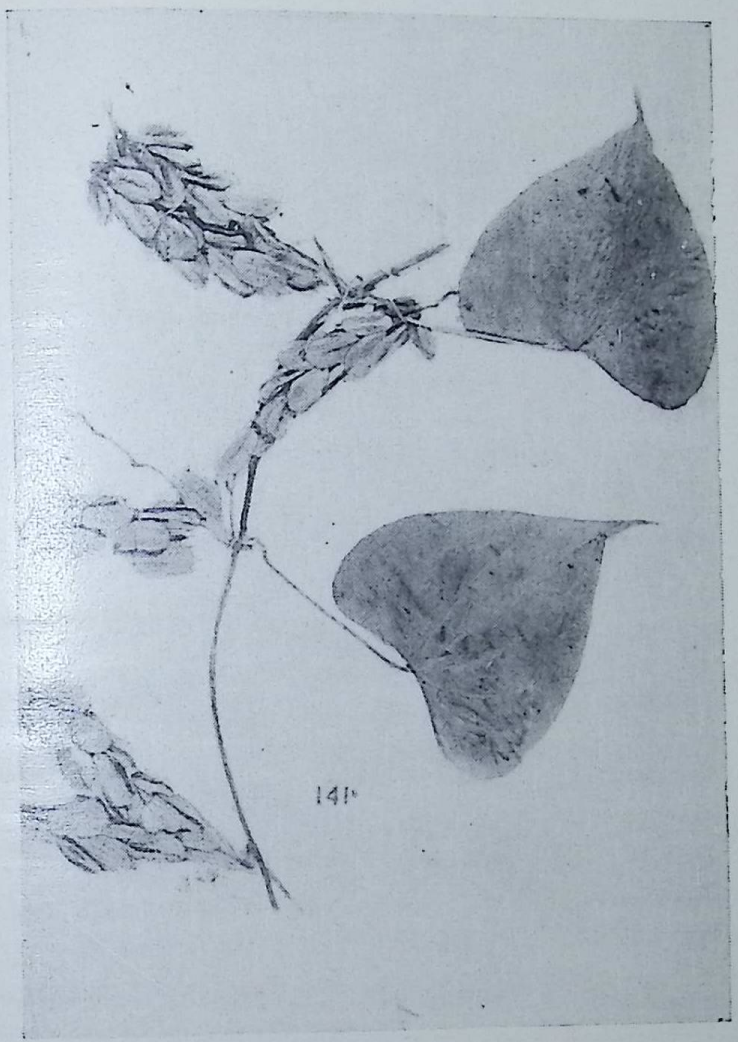

*Dioscorea bulbifera*

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*Dioscorea deltoidea*

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crystalline forms depending on the solvent of crystallisation. The structure for the diterpene lactone has been assigned on the basis of spectroscopic and degradative evidence (Joshi and Rane, 1969).

There has also been a preliminary report of plant development, plant collection, adaptation and domestic potential of *Dioscorea*. Attempts have been made to evaluate and domesticate diosgenin yielding species of *Dioscorea*. Diosgenin is a steroid sapogenin, from which a number of steroid hormones are manufactured. The range in diosgenin content on dry weight basis is from 0·6 to 10·3 per cent in individual clones collected from wild plants (Bammi *et al.*, 1969).

Different constituents have been noticed within the nodal ganglion (nodal plexus) at different periods of development of the vine. Glycosides, carbohydrates, sterols, tannins, proteins, alkaloids and phenolic constituents are found in the leaves and nodal ganglion. Percentage of these vary with season and the maturity of the vine (Karnick, 1970, 1971*a*).

Different parts of *D. deltoidea* and *D. prazeri* have been screened for various constituents. Saponins from the tubers have been hydrolysed into diosgenin from both the plants, but other constituents have been overlooked. Tubers were also rich in glycosides and phenolic compounds; stems, nodes, and leaves were rich in alkaloids, saponins, tannins, proteins and phenolic constituents. Growth studies revealed that percentage of glycosides increased with age, (Karnick, 1971*b*).

*Dioscorea* vines were cultured under different light periods for 3 months and the effects on the composition and percentage of steroidal sapogenins present at different stages of growth were studied (Karnick, 1972).

In the species collected from Almora district in Uttar Pradesh, the diosgenin percentage was found to be from 0·33 to 2·27. These strains have been planted in National Botanic Gardens, Lucknow, for further multiplication and selection (Chandra and Srivastava, 1972).

A comprehensive review on *Dioscorea* has been published (Karnick, 1969). A phytochemical survey of 50 species and varieties of *Dioscorea* has been reported (Karnick, 1971*c*).

**Pharmacology :** The effect of various extracts of the roots of *D. bulbifera*, methylphenidate and ocaine, has been studied on food consumption of rats. The acetone extract of the rhizomes (10-45 mg./kg.) inhibited food intake in 90 and 300 minute tests. Small doses of methylphenidate and cocaine augmented intake of food (Jindal *et al.*, 1969).

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Crystalline saponins isolated from *D. prazeri* and *D. prazeri* var. *glauca* produced a fall of blood pressure in anaesthetized cats in a dose of 0·5 mg./kg. i.v. The fall of blood pressure could be prevented by atropinization (Chakravarti *et al.*, 1969).

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## DIOSPYROS (Ebenaceae)

*D. EBENUM* Koenig.

| | | | | | |
|---|---|---|---|---|---|
| Eng. | — | Ebony | Mal. | — | Karu |
| Hind and Mar. | — | Tendu, abnus | Tam. | — | Kaaraimaram |
| Kan. | — | Karemara | Tel. | — | Nallavalludu |

**Habitat :** Grows in dry evergreen forests of Deccan and Karnataka extending westward to north Coimbatore, south Kanara and Coorg, and southward through Malabar and Cochin to Travancore.

**Parts used :** Whole plant.

**Medicinal properties and uses :** Plant is astringent, attenuant, lithotriptic and fish poison (Chopra *et al.*, 1956; Nadkarni, 1954).

*D. MELANOXYLON* Roxb.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Kend | Tam. | — | Karai |
| Hind. and Mar. | — | Tendu | Tel. | — | Mancigata, tumbi |

**Habitat :** Found in deciduous forests of the Madhya Pradesh, Chota Nagpur, Bihar, and western peninsula.

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**Parts used :** Leaves, flowers and bark.

**Medicinal properties and uses :** Leaves are diuretic, carminative, laxative and styptic. Dried flowers are useful in urinary, skin and blood diseases (Chopra *et al.*, 1956).

*D. MONTANA* Roxb.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Bangab | Tam. | — | Vaakkaanaimaram |
| Hind. | — | Bistendu | Tel. | — | Eddayagata |
| Mar. | — | Goindu | | | |

**Habitat :** Found throughout India.

**Parts used :** Fruits and leaves.

**Medicinal properties and uses :** Fruits are poisonous, applied externally to boils. Crushed leaves and fruits are used for stupefying fish (Chopra *et al.*, 1956; Nadkarni, 1954).

**Chemistry :** From the heartwood of *D. ebenum*, α-amyrenone, α-amyrin, betulin, ceryl alcohol, bauerenol, stigmasterol, ursolic acid and betulinic acid have been isolated (Gupta and Mahadevan, 1967).

From the petroleum ether extract of the leaves of *D. ebenum*, α-amyrin, betulin, lupeol, ursolic acid and an unidentified triterpene alcohol $C_{30}H_{50}O_2$, m.p. 230-32° have been isolated (Gupta and Mahadevan, 1968).

6-hydroxy-4, 5-dimethoxy-2-naphthoic acid and its methyl ester have also been isolated from the heartwood of *D. ebenum* (Gupta and Dhar, 1969).

*D. melanoxylon* yielded a black heartwood known as Coromandal ebony. From this several new naphthols and naphthaquinones have been isolated and characterised (Sidhu—Personal communication).

Isolation and structure elucidation of four new compounds from *D. chloroxylon* has been reported. These are isodiospyrin, the first optically active binaphthaquinone; xylospyrin—the first trinaphthalene quinone; 8-dimethoxy-2, 7-dihydroxy, 3-methyl naphthalene and 1, 2, 7, 8-tetramethoxy-3-methyl naphthalene (Sidhu—Personal communication).

The new monohydroxy triterpene alcohol isolated from the leaves of *D. melanoxylon* has been identified as bauerenol. Diospyric acid was also isolated and was shown to be a mixture of ursolic, oleanolic and betulinic acids (Row and Rao, 1969).

A colouring matter provisionally designated as diospyrin, molecular formula $C_{22}H_{14}O_6$ and three triterpenes identified as lupeol, betulin and betulinic acid have

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been isolated from the stem bark of *D. montana*. Diospyrin has been found to contain two hydroxy and two C-methyl groups. On zinc dust distillation, it gave a crystalline hydrocarbon. Comparison of ultraviolet absorption spectra of diospyrin and its derivatives with those of the known binaphthyls suggested a 2, 2′-binaphthyl structure for diospyrin (Kapil and Dhar, 1961).

Diospyrin was obtained from *D. montana* as orange red cubes, m.p. 286-288°. It showed UV absorption spectrum typical of 1 : 4-naphthoquinones. The presence of two phenolic hydroxyl groups was shown by the formation of a dimethyl ether, $C_{24}H_{18}O_6$, m.p. 330° and a diacetate, $C_{26}H_{18}O_8$, m.p. 260°. Reductive acetylation yielded a crystalline hexaacetate $C_{34}H_{30}O_{12}$ leading to the molecular formula $C_{22}H_{14}O_6$ for diospyrin itself (Ganguly and Govindachari, 1966).

The first naphthaquinone carboxylic acid derivative from higher plants has been isolated from *Diospyros* species and its structure elucidated (Sidhu—Personal communication).

The fruit pulp of *D. preragrina* yielded hexacosane, hexacosanol, β-sitosterol, a monohydroxy ketone, betulin, lupeol, β-D-glucoside of β-sitosterol and sallic acid. The seeds contained betulinic acid (Misra *et al.*, 1971).

Stems and leaves of all the Indian species of *Diospyros* except *D. aegyptica* yielded β-sitosterol. All these contained betulinic acid. Other terpenoid and lipid substances and glycosides were also extracted (Bhakuni *et al.*, 1971).

**Pharmacology :** The alcoholic extract of *D. cardifolia* was found to possess potent anti-inflammatory activity against carageenin-induced oedema in rat hind paw. Out of various chromatographic fractions of the extract, fraction of benezene : chloroform and chloroform alone possessed significant anti-inflammatory activity against carageenin-induced rat hind paw oedema and formaldehyde induced arthritis and cotton pellet implantation in rats. These two fractions also possessed significant antipyretic and analgesic activities as tested against yeast-induced pyrexia in rats and aconitine—induced writhing in mice. The fractions compared well with hydrocortisone and acetylsalicylic acid in these tests (Kohli *et al.*, 1972).

The alcoholic extract of the plant showed CNS depressant activity as judged from ataxia, decreased locomotor activity and loss of righting reflex in mice and rats. It had spasmolytic activity on rabbit and guineapig ileum. The extract produced bradycardia and hypotension in anaesthetized dogs (Singh *et al.*, 1971).

The alcoholic extract of the stem bark of *D. preragrina* was found to have antiprotozoal activity against *Entamoeba histolytica*, anti-viral activity against *Ranikhet disease virus* and hypoglycaemic activity in albino rats (Dhar *et al.*, 1968).

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## DIPTEROCARPUS (Dipterocarpaceae)

*D. INDICUS* Bedd. (Syn. *D. tubinatus* Dyer)

Mal. — Kakka Tam. — Ennaimaram

**Habitat :** Found in evergreen forests of western ghats from north Kanara southwards up to 1000 m.

**Parts used :** Oleo-resin.

**Medicinal properties and uses :** It is used in rheumatism.

*D. PILOSUS* Roxb.

**Habitat :** Grows in Sylhet, Chittagong, south Tipperah and Andamans.

**Parts used :** Oelo-resin.

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**Medicinal properties and uses :** It is used in gonorrhoea and other discharges from the urogenital tract (Chopra *et al.*, 1956).

**Chemistry* :** The essential oil from *D. indicus* has been found to contain humulene, β-carophyllene, a bicyclic sesquiterpene hydrocarbon and a sesquiterpene alcohol, the latter two giving cadalene on dehydrogenation (Rao *et al.*, 1952).

The triterpene fraction (80 per cent) of the oleoresin from *D. pilosus* has been found to contain dipterocarpol and several known (dammara-20, 24-dien-3-one, dammara 24--one-3, 20-diol, ocotillone-II, ocotillol-II) and new triterpenes related to this. Structure elucidation of these two new triterpenes *viz.* holongdione and dipterocarpolic acid has been described. The resin also contained significant quantities of asiatic acid and two of its acetyl derivatives and 2 α-hydroxy ursolic acid (Gupta and Sukh Dev, 1971*a*).

Oleoresin from *D. pilosus* has been shown to be a complex blend of sesquiterpenes and triterpenoids, both tetracyclic and pentacyclic. A complete analysis of the sesquiterpene portion has been carried out. Besides the known caryophyllene, humulene, caryophyllene oxide, humulene epoxide—II and clovane-diol, seven new sesquiterpenes have been isolated and the structure of three of these, humulene epoxide-III, caryophyllenol-I and caryophyllenol-II has been elucidated (Gupta and Sukh Dev, 1971*b*).

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Gupta, A.S. and Sukh Dev. 1971*b*. Studies in sesquiterpenes. Sesquiterpenes from the oleoresin of *Dipterocarpus pilosus* : Humulene epoxide-III, caryophyllenol-I and caryophyllenol-II. **Tetrahedron 27,** 635.

Rao, G.S.K., Sukh Dev and Guha, P.C. 1952. Studies in sesquiterpenes, Part VIII. Sesquiterpenes of the essential oil from *Dipterocarpus indicus* Bedd. **J Indian Chem Soc 29,** 589.

## DOLICHOS (Papilionaceae)

*D. BIFLORUS* Linn. (Syn. *D. uniflorus* Lamk.)

Ben. and Guj. — Kulti
Eng. — Horse gram
Hind. — Kulthee
Kan. — Huruli
Kon. — Kuitthu
Mal. — Kullu
Mar. — Hulga
Tam. — Kollu
Tel. — Ulavalu

*No report available on other aspects.

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**Habitat :** A common twining plant growing all over India, specially in Bombay and Madras.

**Parts used :** Seeds.

**Ayurvedic description**

Sanskrit : *Kulaatha*

Synonyms : *Kulathika, taamrabeeja, shwetabeeja, sitetara*

Properties : *Rasa* — *Kashaaya*
*Guna* — *Laghu, rooksha*
*Veerya* — *Ushna*
*Vipaaka* — *Katu* (*amla* ?)

Actions/Uses : *Graahi, vidaahi, balya, shophaghna, kaasapeenasahara, hikkaahita, shwaasahita, arshohita, shukraasmareehara, gulmaghna, aanaahasha-, mana, medog hna, gudakeelakahara, raktapittaghna, udararogaghna*

**Medicinal properties and uses :** Seeds are used as astringent, diuretic and tonic (Nadkarni, 1954).

**Chemistry :** The amino acid composition of the whole seed, alcoholic extract and residue of tender and mature beans (*D. lablab*) were determined by microbiological assay. There was no amino acid make-up in tender and mature beans (Nagabhushanan *et al.*, 1962).

**Clinical studies :** A few patients with ascites and oedema of legs were treated with aqueous extract of the seeds of *D. biflorus*, 8 oz. daily in divided doses. The daily fluid intake was kept almost constant in all the cases. The results obtained indicated the diuretic activity of the extract. The preparation was well tolerated (Banerjee *et al.*, 1957).

## References

Banerjee, B., Chakravarti, R.N. and Chaudhuri, R.N. 1957. Seeds of *Dolichos biflorus* as diuretic. **Bull Calcutta Soc Trop Med 5,** 71.

Nagabhushnan, A., Srinivasan, K.S. and Srinivasan, M. 1962. Amino acid composition of tender and mature field beans (*Dolichos lablab*). **Indian J Med Res 50,** 916.

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## DRYOPTERIS (Polypodiaceae)

*D. BARBIGERA* (Moore) Kuntze

**Habitat :** Grows in alpine Himalayas from Kashmir to Sikkim.

**Parts used :** Rhizome.

**Medicinal properties and uses :** Rhizomes possess anthelmintic properties.

*D. FILIX-MAS* (Linn.) Schott.

Eng. — Male Fern

**Habitat :** Found in temperate regions.

**Parts used :** Rhizomes.

**Medicinal properties and uses :** Rhizomes are used as anthelmintic (Chopra *et al.*, 1956).

**Pharmacognosy* :** The species of *Dryopteris* contain much filicin. A good field test for species rich in active principle is a greenish tinge of the cut surface of the rhizome and stipe bases, the colour of which is retained long after drying. On pharmacognostic study, it has been found that species containing oleoresin and filicin, invariably show large schizogenously developed cavities within the ground tissue of the rhizome and the petiole bases. The rhizomes and petiole show the usual fern structure. A key has been provided for differentiation of the species (Mehra and Mittal, 1961*a*).

The genus *Dryopteris* is characterised by the presence of schizogenous cavities and internal glands, there being few exceptions. The glands possess a short or long stalk with rounded, pyriform or club-shaped head. In the closely allied genus *Ctenitis*, schizogenous cavities and internal glands are present, at least in the two species. The shape of these is, however, different from that of *Dryopteris* sps. being cylindrical. The active principle filicin is secreted by the internal glands present in the schizogenous cavities of the ground tissue. There is no case recorded so far where internal glands are present but filicin absent or *vice-versa*. There is a certain degree of correlation between the secreting surface and the amount of secretion of filicin. Besides this, an internal or genetic factor controls the process. The amount of filicin does not increase in relation to the chromosome numbers in natural tetraploids compared to the diploids (Mehra and Mittal, 1961*b*).

A macro and microscopic description of the rhizome and leaf bases of *D. barbigera* and *D. cochleata* has been presented. Both the species compare very favourably in

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oleoresinous content and crude filicin with the official male fern. The two species are differentiated from each other on the basis of the shape and size of the rhizome, structure of the ramenta present on the rhizomes, absence of dark sclerotic nests in the ground tissue, the number of cauline vascular bundles, and the shape and size of stalk of internal unicellular glandular hairs. *D. barbigera* is monomorphic and *D. cochleata* is strongly dimorphic. The rhizome of *D. cochleata* is flattened, cylindrical with frond bases distantly situated. The rhizome of *D. barbigera* is ovoid, oblong, or elongated in shape with numerous closely arranged frond bases. Rhizomes of both the species are covered all over by the ramenta. Size and structure of the ramenta is characteristic in each species (Mehra and Mittal, 1962).

The histological pattern in both the species is similar except for the presence of scattered dark spots of sclerotic cells and nests in the ground tissue of the rhizome and stipe bases of *D. cochleata,* which are absent in *D. barbigera.* Both the species possess schizogenous cavities, distributed in the ground tissue, into which project characteristic unicellular secretory glandular hairs. The secretory glands possess longer stalks in *D. barbigera* than in *D. cochleata.* The base of the stalk is slightly swollen only in *D. cochleata.* The number of cauline meristeles and leaf traces are less in *D. cochleata* than in *D. barbigera* (Mehra and Mittal, 1962).

### References

Mehra, P.N. and Mittal, T.C. 1961*a*. Indian substitutes of male fern. **Nature 186,** 722.

Mehra, P.N. and Mittal, T.C. 1961*b*. Significance of internal secretory glands in relation to filicin. **Planta Med 9,** 189.

Mehra, P.N., and Mittal, T.C. 1962. Pharmacognosy of Indian substitutes of male fern II. *Dryopteris barbigera* and *D. cochleata.* **J Pharm Sci 51,** 367.

## ECBOLIUM (Acanthaceae)

*E. LINNEANUM* Kurz. (Syn. E. *viride* (Forsk) Merrill)

| | | | | | |
|---|---|---|---|---|---|
| Ben and | | | Mar. | — | Dhakta-adulsa |
| Hind. | — | Udajati | Tam. | — | Nilambari |
| Mal. | — | Odiyamadantha | Tel. | — | Chikatikuratappa |

**Habitat :** Grows at Konkan, western ghats, Deccan, Karnataka and north east India.

**Parts used :** Whole plant, roots and leaves.

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**Medicinal properties and uses :** Roots are used in jaundice, menorrhagia and rheumatism. The plant is used for gout and dysuria (Chopra *et al.*, 1956).

**Pharmacognosy*** : Plants have bluish bifid flowers in dense spikes. Large imbricate, 4-ranked bracts are present. Leaf lamina is oblong-lanceolate tapering at both ends and has very short petioles. Large oval glandular trichomes with dense contents are present on leaf and stem periphery. Woody tissue in stem is porous with mostly solitary pores and with heterogenous rays containing microcrystals and internal phloem. Leaves have caryophyllaceous type of stomata. Palisade ratio, stomatal index and vein-islet number have been determined. Roots possess abundant thick-walled fibres in the secondary xylem (Dutta and Maiti, 1968).

**Reference**

Datta, P.C. and Maiti, R.K. 1968. Pharmacognostic study on *Ecbolium linneanum* Kurz. var. *dentata* Clarke. **Quart J Crude Drug Res 8,** 1189.

## ECHINOPS (Compositae)

*E. ECHINATUS* DC.

Eng. — Camels thistle  Hind. — Utkanta
Guj. — Utakanto

**Habitat :** Found in Himalayas, central India, Konkan, Deccan and Marwar.

**Parts used :** Whole plant, root, root bark, leaves and fruit.

**Ayurvedic description**

Sanskrit : *Utkantaka*

Synonyms : *Kantaphala, raktapushpa, brahmadandi, karabhaadana, ushtrakantha, kantaalu, shrugaalashunakaashana, vrittaguchcha*

Properties : *Rasa* — *Katu, tikta* (*madhura* ?)
*Guna* — *Laghu*
*Veerya* — *Ushna*
*Vipaaka* — *Katu*

*No report available on other aspects.

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Actions/Uses : General : *Ruchidaa, vrishya, mootrakrichrahara, mehaghna, trishnaahara*
Root : *Streenaamsheeghraprasavakaaraka*

**Medicinal properties and uses :** It is an aromatic, bitter, nervine tonic, alterative, diuretic and aphrodisiac (Nadkarni, 1954).

**Chemistry* :** The air-dried plant on cold percolation with 70 per cent alcohol and further concentration of the extract yielded a residue which was acidified and then extracted with benzene. The residue left behind on evaporation of the benzene extract was saponified and the saponified material thus obtained was extracted with ether. It yielded a white crude solid, which was chromatographed over alumina with various solvents. The compounds isolated in pure crystalline form were hentriacontane, m.p. 68-70°, $C_{31}H_{64}$; hentriacontanol, m.p. 85-87°, $C_{31}H_{64}O$; β-amyrin, m.p. 197-98°, $C_{30}H_{50}O$ and lupeol, m.p. 215-16°, $C_{30}H_{50}O$ (Sen *et al.*, 1968).

### Reference

Sen, A.B., Dhar M.M. and Shukla Y.N. 1968. Chemical examination by *Echinops echinatus*. **J Indian Chem Soc 45,** 697.

## ECLIPTA (Compositae)

*Eclipta alba* has been largely used in the treatment of derangement of the liver and gall bladder and as a substitute for *Taraxacum*. This plant was initially confused with *Wedelia calendulacea* having yellow flowers called as *Pila Bhangra*. From this, a new lactone named *wedelolactone* was isolated, which was later found to be present in *E. alba* also. Hence, *W. calendulacea* has been reported to be a substitute of *E. alba* (Mehra and Handa, 1968).

*E. ALBA* Hassk.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Kesuria | Mar. | — | Maka, bhangra |
| Hind. | — | Mochkand | Tam. | — | Kaikeshi |
| Kan. | — | Bhringaraja, ganiga | Tel. | — | Galagara |

*No report available on othe- aspects.

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**Habitat :** Common weed growing in moist places throughout India, ascending up to 2000 m. on the hills.

**Parts used :** Leaves and roots.

**Ayurvedic description**

Sanskrit : *Bhringaraaja*

Synonyms : *Maarkawa, kesharaaja, kesharanjana, bhringaara, neela*

Properties :

| | | |
|---|---|---|
| *Rasa* | — | *Tikta, kashaaya* |
| *Guna* | — | *Rooksha* |
| *Veerya* | — | *Ushna* |
| *Vipaaka* | — | *Katu* |

Actions/Uses : *Keshya, chakshushya, vishaghna, rasaayana, balya, twachya, dantya, kaphashophahara, aamadoshaghna, paandughna, twagrogahara, hridrogahara, vishaghna, krimihara, shwaasaghna, kaantaarogahara, netrarogahara, shirorogahara*

**Medicinal properties and uses :** Whole plant is tonic and deobstruent in hepatic and spleen enlargements and is emetic. Plant juice in combination with aromatics is administered for catarrh and jaundice. Leaf juice along with honey is used as a remedy for catarrh in infants. Root is emetic, purgative and is applied externally as an antiseptic to ulcers and wounds in cattle (Chopra *et al.*, 1956; Nadkarni, 1954).

**Pharmacognosy :** Macroscopic characters : The plant is an annual herb, having a round to flat stem with longitudinal grooves and deep brown in colour. Leaves are opposite and sessile to subsessile. Receptacle is flat, covered with broad, folded scales, enclosing several flowers. Achenes are narrowly ablong and ribbed with pappus teeth.

Microscopic characters : The leaf epidermis is composed of a single layer of parenchyma cells with characteristic, non-glandular trichomes on both the surfaces.

In transection, the stem is circular in outline with a ring of collateral endarch vascular bundles of varying sizes and a central parenchymatous pith. The root has a diarch structure with normal and secondary growth. Prominent multicellular secondary xylem rays are seen. The endodermis is indistinct. Few layers of cork cells are present. Ash values have also been determined (Mehra and Handa, 1968).

**Chemistry :** Preliminary phytochemical screening indicated the presence of reducing sugars in the alcoholic extract of leaves and whole plant. Presence of sterols was

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confirmed in petroleum ether extract of seeds. Wedelolactone (m.p. 325-330°) was obtained from the leaves and stem. The alcoholic solution of the crystals gave dark green colour with ferric chloride. The crystals were soluble in warm pyridine (Mehra and Handa, 1968).

The petroleum ether extract of the dry leaves was hydrolysed with methanolic alkali, diluted and extracted with ether. On chromatography it yielded stigmasterol and the subsequent eluates yielded a sulphur compound in the form of lemon-yellow plates from benzene having m.p. 150-151°. It analysed for $C_{13}H_{10}S_3O$. The UV spectrum showed that it might be a derivative of α-terthienyl. Taking into consideration all the properties, particularly UV and NMR spectral data, the complete structure of the compound has been worked out to be α-terthienyl methanol (Krishnaswamy *et al.*, 1966).

*E. alba* contained wedelolactone and desmethylwedelolactone besides sulphur-containing peptides. The presence of two thiophene derivatives and a polyacetyllenic compound in this plant has also been reported. Later, a new polythienyl compound was isolated whose structure was determined as α-terthienylmethanol, besides β-amyrin and stigmasterol. The alcohol extract of this plant has revealed the presence of desmethylwedelolactone and a new glycoside whose consitution has been established as desmethylwedelollactone 7-glucoside (Bhargava *et al.*, 1970).

**Pharmacology :** The alcoholic extract of the entire plant *E. alba* has been reported to have antiviral activity against *Ranikhet disease virus* (Dhar *et al.*, 1968).

### References

Bhargava, K.K., Krishnaswamy, N.R. and Seshadri, T.R. 1970. Isolation of desmethylwedelolactone and its glucoside from *Eclipta alba*. **Indian J Chem 8,** 664.

Dhar, M.L., Dhar, M.M., Dhawan, B.N., Mehrotra, B.N. and Ray, C. 1968. Screening of Indian plants for biological activity. Part I. **Indian J Exptl Biol 6,** 232.

Krishnaswamy, N.R., Seshadri, T.R. and Sharma, B.R. 1966. The structure of a new polythienyl from *Eclipta alba*. **Tetrahedron Lett 35,** 4227.

Mehra, P.N. and Handa, S.S. 1968. Pharmacognosy of Bhringraja—antihepato-toxic drug of Indian origin. **Indian J Pharm 30,** 284.

## ELAEOCARPUS (Elaeocarpaceae)

*E. GANITRUS* Roxb. (Syn. *E. sphaericus* K. Schum.)

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Rudraakya | Sans. | — | Rudraaksha |
| Mar. | — | Rudroksh | Tam. Tel. Mal. and Kan. | — | Rudraksha |

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**Habitat :** Found in Bihar, Bengal, Assam, Madhya Pradesh, Bombay and Nepal and occasionally cultivated as an ornamental tree.

**Parts used :** Fruit.

**Medicinal properties and uses :** The fruit is used in diseases of the head and epileptic fits (Chopra *et al.*, 1956).

**Pharmacology* :** A resinuous gummy material obtained on evaporation of the ethyl-acetate extract of the seeds produced a persistent pressor effect of moderate intensity in anaesthetized cats and dogs (Sarkar *et al.*, 1972*a*). It produced positive inotropic and negative chronotropic effect in intact heart of cats and dogs and isolated heart of guineapig, rabbit and cats. The positive inotropic effect was found to be independent of adrenergic or histaminergic mechanism. ECG studies revealed cardiac glycoside-like effect (Sarkar *et al.*, 1972*b*). The extract produced enhancement of rate and force of contraction of normal and hypodynamic hearts. The coronary flow was also found to be increased (Sarkar *et al.*, 1973). It was found to be non-toxic in mice and rats (Sarkar *et al.*, 1972*b*).

The alcoholic extract of the stem bark of *E. ganitrus* showed hypoglycaemic activity in albino rats. It also possessed CNS depressant activity in mice (Dhar *et al.*, 1968).

## References

Dhar, M.L., Dhar, M.M., Dhawan, B.N., Mehrotra, B.N. and Ray, C. 1968. Screening of Indian plants for biological activity. Part I. **Indian J Exptl Biol 6,** 232.

Sarkar, P.K., Sengupta, S.S. and Bhattacharya, S.S. 1972*a*. Effect of *Elaeocarpus ganitrus* Roxb. seeds on blood pressure. **Indian J Pharmac 4,** 128.

Sarkar, P.K., Sengupta, S.S. and Bhattacharya, S.S. 1972*b*. Studies with ethylacetate extract of *Elaeocarpus ganitrus* seeds on mammalian hearts-intact and isolated preparations. **Indian J Pharmac 4,** 129.

Sarkar, P.K., Bhattacharya, S.S. and Sengupta, S.S. 1973. Further observations with *Elaeocarpus ganitrus* on normal and hypodynamic hearts. **Indian J Pharmac 5,** 252.

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*No report available on other aspects.

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# ELEPHANTOPUS (Compositae)

*E. SCABER* Linn.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Gojialata | Kan. | — | Hakkarike |
| Eng. | — | Prickly leaves, elephants foot | Mar. | — | Gojibha |
| | | | Tam. | — | Anashavadi, aanaichchuvadi |
| Hind. | — | Gobhi, Gaojban | | | |
| | | | Tel. | — | Hustikasaka |

**Habitat :** Grows throughout India in shady places specially in Bengal.

**Parts used :** Root and leaves.

**Ayurvedic description**

Sanskrit : *Gojihwaa*

Synonyms : *Kharapatra, daarveepatra, gojee, gobhee, daarveeka, moolaghna, ksheerinee, deerghapatra, kharadala, shubhaa, chakravat, madhyadandasthira, peeta, godhoomika, kroshtashoolika, golee, bhoomikaalika*

Properties : *Rasa* — *Katu, madhura, kashaaya*
*Guna* — *Laghu* (*snigdha* ?)
*Veerya* — *Sheeta*
*Vipaaka* — *Madhura*

Actions/Uses : *Graahi, balya, hridya, vranaropanee, pramehaghna, kaasaghna, vranahara, jwaraghna, dantarogaghna, vishaghna, raktapittahara, aruchighna, shwaasaghna, pramehaghna.*

**Medicinal properties and uses :** The plant is mucilaginous and is used as cardiac tonic, astringent, alterative and febrifuge. Decoction of the root and leaves with cumin and buttermilk is given in dysurea and other urethral complaints; also given in diarrhoea and dysentery. The drug is used in snake bite also (Nadkarni, 1954).

**Chemistry* :** A new sesquiterpene dilactone, deoxyelephantopin, has been isolated from the plant and its structure established by spectral studies and chemical correlation with elephantopin (Govindachari *et al.*, 1970).

Another new sesquiterpene dilactone isodeoxyelephantopin has also been isolated from the plant. Chemical degradation and comparison of the NMR data of the new sesquiterpene with those of deoxyelephantopin, elephantopin, and elephantol methacrylate conclusively showed that the compound differed from deoxyelephantopin in

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the configuration at C-2 or C-8. The studies further showed that the double bond at $C_4$-$C_5$ has a transorientation of methyl and hydrogen since saturation of methyl signal causes no significant enhancement in the areas of vinyl proton signal (Govindachari *et al.*, 1972).

### References

Govindachari, T.R., Sidhaye, A.R. and Viswanathan, N. 1970. Deoxyelephantopin, a new sesquiterpene from *Elephantopus scaber* Linn. **Indian J Chem 8,** 762.

Govindachari, T.R., Viswanathan, N. and Fuhrer, H. 1972. Isodeoxyelephantopin, a new germacranodiolide from *Elephantopus scaber* Linn. **Indian J Chem 10,** 272.

## ELEUSINE (Graminae)

*E. CORACANA* Gaertn. (Syn. *E. indica* Gaertn.).

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Muroca | Kon. | — | Nanchano |
| Eng. | — | Indian millet | Mar. | — | Nachni |
| Guj. | — | Bavto | Punj. | — | Chalodra |
| Hind. | — | Makra | Tel. | — | Ragulu |
| Kan. Mal. and Tam. | — | Ragi | | | |

**Habitat :** This cereal is grown almost in all parts of India.

**Parts used :** Seeds.

**Medicinal properties and uses :** Seeds are tonic, cooling, useful in biliousness and are also astringent (Chopra *et al.*, 1956; Nadkarni, 1954).

**Chemistry* :** Changes in the concentration of total lipids, ubiquinone (COQ), plastoquinone (PQ) and tocopherols during different stages of germination of Ragi (*Eleusine coracana*) and Thinai (*Panicum italicum*) have been studied. The degree and magnitude of changes suggested that saponifiable lipids were being consumed and that COQ, PQ and tocopherols undergo transformation during germination (Garg and Krishna Murti, 1962).

*No report available on other aspects.

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**Reference**

Garg, N.K. and Krishna Murti, C.R. 1962. Tocopherol and ubiquinone changes during germination. **J Sci Industr Res 21C**, 103.

## ELSHOLTZIA (Labiatae)

*E. INCISA* Benth.

**Habitat :** A tender herb, found in temperate and subtropical Himalayas from Kashmir to Mussorie at 1200 m.

**Chemistry :** The dried leaves and flowering tops of *E. incisa* collected from Reasi forests were subjected to hydrodistillation. A pale yellow oil with strong smell of thymol was obtained (0·88 per cent). The oil possessed the following properties : sp. gr. at 25°C 0·9397, refractive index at 25°C 0·5050, percentage of phenols calculated as thymol was 53·8. For the first time, the occurrence of thymol in substantial quantities in the genus *Elsholtzia* has been reported (Sarin and Prabhakar, 1966).

**Pharmacology :** The alcoholic extract of the entire plant *E. cristata* showed CNS depressant activity in mice (Bhakuni *et al.*, 1971).

**References**

Bhakuni, D.S., Dhar, M.L., Dhar, M.M., Dhawan, B.N., Gupta, B. and Srimal, R.C. 1971. Screening of Indian plants for biological activity : Part III. **Indian J Exptl Biol 9**, 91.

Sarin, Y.K. and Prabhakar, V.S. 1966. *Elsholtzia incisa* Benth. A new source of thymol in north-west Himalayas. **Curr Sci 35**, 604.

## EMBELIA (Myrsinaceae)

*E. RIBES* Burm. (Syn. *E. glandulifera* Wight)

| | | | |
|---|---|---|---|
| Ben. | — Biranga | Mar. | — Vavadinga |
| Guj. and Hind. | — Karkannie | Punj. | — Babrung |

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*Elsholtzia cristata*

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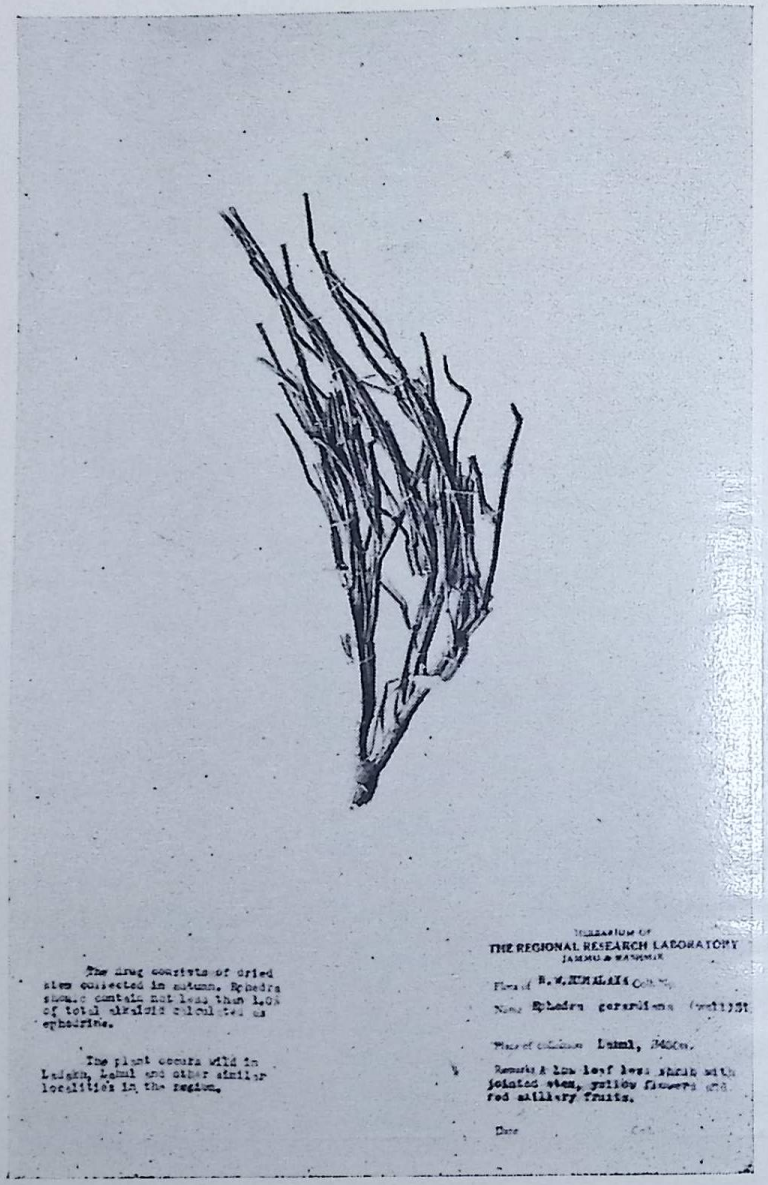


*Ephedra girardiana*

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| | | | |
|---|---|---|---|
| Kan. | — Vayuvilanga | Tam. | — Vaayuvilangam |
| | | Tel. | — Vellal |

**Habitat :** The climber is found in the hilly parts of India from central and lower Himalayas down to Ceylon and Singapore.

**Parts used :** Berries, leaves and root-bark.

**Ayurvedic description**

Sanskrit : *Vidanga*

Synonyms : *Krimighna, krimihantra, bhootaghna, jantunaashanee, chitratandula, tandula, vellaa, amogha, kairala,*

Properties : *Rasa* — *Katu, kashaaya, ishad tiktam*
*Guna* — *Laghu, rooksha, teekshna*
*Veerya* — *Ushna*
*Vipaaka* — *Katu*

Actions/Uses : *Deepani, ruchya, krimighna, vishtambhi, vanhikara, vishahara, : krimi-doshanaashanee, aamadoshahara, medoghna, aadhmaanahara, shool-aghna, mehaghna, agnimaandyashamanee*

**Medicinal properties and uses :** Fruits are carminative, anthelmintic, stimulant and alterative. Pulp is purgative. Fresh juice is cooling, diuretic and laxative (Nadkarni, 1954). Infusion of roots is given for coughs and in diarrhoea (Chopra *et al.* 1956.)

**Pharmacognosy :** Fruits of *Embelia ribes* contain 2·5-3·1 per cent of embelin which is its active chemical constituent. Commercial samples available in the market contain up to 50 per cent or even more of *E. robusta* fruits. The latter contain only 1·6 per cent of embelin. The morphological characters of these fruits have been described. The distinghuishing pharmacognostic characters of the fruit of *E. ribes* are : greyish black colour with a warty surface; epicarp has rounded cells with wrinkled cuticle; fibrovascular bundles occur irregularly and endocarp has a single row of palisade-like stone cells. Fruits of *E. robusta* are bigger, reddish in colour, longitudinally wrinkled, tangentially elongated; volatile oil glands are present in outer mesocarp and 3 to 6 layers of stone cells are present in inner mesocarp. Both the fruits show chemical tests for embelin (Shah and Khanna, 1961).

The morphological and microscopical characters of *E. ribes* and *E. tsjeriamcottom* have been described. Fruits of latter species are 4-5 mm. in diameter. In transection the cells of the epicarp are polygonal, elongated and with striated cuticle. The fruits of *E. tsjeriamcottom* can be distinguished by the presence of characteristic oil glands which are not found in *E. ribes.* On the other hand, fruits of *E. ribes* are

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globular, 2·4 to 4 mm. in diameter, with warty surface. Colour is dirty black, rarely dirty red (Patel *et al.*, 1964).

A study of the morphological characters of root, stem, leaf, flower, fruit and seed has been made on authentic specimens of *E. ribes* collected from Meghalaya. The distribution of the plant within the country and the possiblity of collection of fruits on a commercial scale from the border region of Meghalaya have also been explored (Shah and Kapoor, 1971).

**Chemistry :** A simple colorimetric method for the estimation of embelin in *E. ribes* based on the colour reaction between embelin and emetine, has been evolved. The colour intensity has been found to be directly proportional to the concentration of embelin (Sarin and Ray, 1961).

Originally the quinone, embelin was considered to be the only component of the berries of *E. ribes*. Rao and Venkateswaralu (1961) found that samples of berries obtained in Waltair contained also vilangin which contained two units of embelin with a $CH_2$ bridge. More recently embelin itself has been found, by mass spectral analysis, to be an inseparable mixture of three components (1) with $C_9$ side chain (homo embelin), (2) with $C_{11}$ chain (embelin) and (3) with $C_{13}$ chain (rapanone). The first occurs only in traces and the other two are major components, 100 parts and 69 parts respectively (Khurana *et al.*, 1972).

**Pharmacological and clinical studies :** The aqueous extract of the berries of *E. ribes* was found to have anti-fertility activity. It checked implantation in almost all the rats which were fed with the extract in a dose of 100 mg./kg. The aqueous extract in the form of tablets had a high degree of efficacy, but a higher dose was required to achieve similar results. The alcoholic extract was partially effective in checking implantation while the petroleum-ether extract was only feebly effective. The antifertility activity of the fruits appeared to be due to its anti-oestrogenic property. The action of oestrogen on the uterus was antagonised by the drug. Acute and subacute toxicity studies with the drug did not reveal any toxic effects (Arora *et al.*, 1971).

Clinical studies were conducted with the alcoholic and aqueous extracts of berries of *E. ribes*, obtained by percolation method, on 40 children infected by ascarides. The alcoholic extract was found very effective in the treatment of 80 per cent of the cases, while aqueous extract cured 55 per cent cases, rendering stools free from the ova. The worms were also expelled from the stools. No purging was required. No evidence of toxicity was observed during and after treatment. There was slight improvement in haemoglobin percentage of the blood. There was a marked reduction in the ova even in those cases which could not be rendered free of ova, indicating that these cases probably required another course of treatment for effective cure. The only common symptom of the disease was pain in the abdomen in 75 per cent of the cases (Guru and Mishra, 1966).

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The seeds of *E. ribes* markedly inhibited estrogen-induced alkaline phosphatase activity in the endometrium of immature rabbits (Chakravarti, 1961).

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# EMBLICA (Euphorbiaceae)

*E. OFFICINALIS* Linn. (Syn. *Phyllanthus emblica* Linn.)

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Amlaki | Kan. and Mal. | — | Nellikayi |
| Eng. | — | Emblic myrobalan, Indian gooseberry | Kash. | — | Aonla |
| Guj. | — | Ambla, Amla | Mar. | — | Amla |
| Hind. | — | Amla | Tam. and Tel. | — | Nelli |

**Habitat :** Found in Deccan, the sea-coast districts and Kashmir.

**Parts used :** Dried fruit, seed, leaves, root-bark and flowers.

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**Ayurvedic description**

Sanskrit : *Aamalaki*

Synonyms : *Dhaatree, vayasya, tishyaphala, shreephala, seeduphala, amritaphala, tishya, vrishya, vrishyaphala, sheetaphala, amrita, shiva, jaateerasaphala, divya, dhara, amritodbhava, dhaatreephala, kolam, karaamalakam, shukti*

Properties : *Rasa* — all *rasas* except *lavana*
*Guna* — *Laghu, rooksha*
*Veerya* — *Sheeta*
*Vipaaka* — *Madhura*

Actions/Uses : *Daahaprashamanee, chakshushya, keshya, medhya, rochanee, deepanee, hridya, rasaayana, vrishya, shukrala, swedahara, medohara, bhagnasandhaanakara, pipaasashamani, chardhighna, pramehaghna.*

**Medicinal properties and uses :** Fresh fruit is refrigerant, diuretic and laxative. Green fruit is very acidic. Fruit is also carminative and stomachic. Dried fruit is sour and astringent. Flowers are cooling and aperient. Bark is astringent (Nadkarni, 1954).

**Chemistry :** By means of paper chromatographic study, the air dried fruits (*amla*) have been found to contain some 13 separable tannins in addition to three or four colloidal complexes. Starch, insulin, silk, wool and anion-exchange resin IR45 have been found to be suitable as adsorbents for a selective separation and isolation of individual tannins by the technique of column chromatography (Dhar *et al.*, 1956).

The effect of phenylalanine and glucose on growth and phyllembelin production was studied in *E. officinalis* tissue cultures. The unorganised tissue cultures were established from seedlings on revised Murashige and Skoog's medium (RT). The growth indices and the amount of phyllembelin from the tissue grown on different media were calculated at the time intervals of two, four, six and eight weeks. The tissues grown on 0·025 per cent and 0·05 per cent phenylalanine and 1 per cent and 2 per cent glucose supplemented RT media showed increase in growth rate in four, six and eight weeks when compared with growth rate of tissues grown on RT medium alone. The tissues grown on RT medium singly supplemented with 0·1 per cent phenylalanine and 3 per cent glucose showed decline in growth rate. The amount of phyllemblin was found to be higher in all the tissues except those which were grown on RT medium. Phyllemblin was maximum in six weeks old tissues in all the instances Maximum production of phyllemblin (5·20 mg./dry weight) and growth rate was observed in tissues grown on RT medium supplemented with 2 per cent glucose (Khanna and Nag, 1972).

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**Pharmacological and clinical studies :** Phyllemblin, isolated from the ethanolic extract of the fruit pulp has been found to potentiate the action of adrenaline *in vitro* and *in vivo*. It showed a mild depressant action on CNS and also had a spasmolytic activity. The drug also revealed mild stimulant action on isolated frog heart, short and insignificant rise in cat's blood pressure, contraction of the nictitating membrane, the reduction of outflow of the perfusate in the hind limb of rat and ear of rabbit, mild cerebral depressant action and anti-spasmodic activity. Of the indirect actions, potentiation of the action of adrenaline on the blood pressure of cat, isolated frog heart, and nictitating membrane of cat and the prolongation of the hypnosis were observed (Rao and Siddiqui, 1964).

Further studies on the actions of phyllemblin revealed that the drug antagonised the spasmogenic effect of acetylcholine, bradykinin and serotonin on the guineapig ileum. It also antagonised serotonin and acetylcholine-induced contractions of oestrogenised rat uterus. It increased the amplitude of cardiac contraction and heart rate transiently. An increase in coronary flow was followed by persistent decrease. On perfused rat hind limb and rabbit ear preparation, phyllemblin in small doses, increased the amount of perfusate whereas in larger doses it decreased the flow significantly. A triphasic response i.e. initial transient rise, followed by a transient fall and then sustained rise in blood pressure was seen in anaesthetised albino rats. The sustained rise was blocked by phentolamine (1 mg./kg.). The drug produced 80 per cent protection against leptazol seizures in mice. It protected effectively against tremors and clonic and tonic convulsions induced by nicotine. It also antagonised tremorine-induced tremors and other cholinergic symptoms (Khurana *et al.*, 1970).

The ether extract and 80 per cent alcoholic extract of fruits acidified with hydrochloric acid, were found to have antibacterial activity. The other extract of the acidified alcoholic extract showed the highest activity, inhibiting the growth of *M. pyogenes* var. *aureus*., *S. typhosa* and *S. paratyphi* at a concentration of 0·21 mg./ml. and that of *M. pyogenes* var. *albus*; *S. schottmmelleri* and *S. dysenteriae* at a concentration of 0·42 mg./ml. (Khorana *et al.*, 1959).

The alcoholic extract of the fruit of *E. officinalis* was found to have anti-viral properties (Dhar *et al.*, 1968).

The effect of *amalaki rasayana* on total serum protein and its fractions was studied in rabbits. The drug had no significant effect on the levels of serum protein fractions, but it raised the total protein level and increased the body weight. The studies indicated that the increase in body weight was due to positive nitrogen balance. The drug was found to have only anabolic effect without affording resistance against diseases (Tewari *et al.*, 1968).

Clinical studies were conducted to investigate the effect of *amalaki* in *amlapitta* (gastritis syndrome). *Amalaki churna* was given in 20 cases in a dose of 3 g., three

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times a day for 7 days. The drug was found effective in 85 per cent of cases. It was observed that the drug did not have any significant beneficial effect in cases of hypochlorhydria. Only cases of hyperchlorhydria with burning sensation in abdominal and cardiac regions and epigastric pain were benifitted (Singh and Sharma, 1971).

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## ENHYDRA (Compositae)

*E. FLUCTUANS* Lour.

Ben. — Hingcha Hind. — Harkuch

**Habitat :** Found in eastern Bengal, Assam and Sylhet.

**Parts used :** Leaves.

**Ayurvedic description**

Sanskrit : *Hilmochika*

Synonyms : *Braahmi, shankhadhara, achari, matsyaakshi*

Properties : *Rasa* — *Tikta*
*Guna* —
*Veerya* — *Sheeta*
*Vipaaka* — *Katu*

Actions/Uses : *Shotaghna, kushtaghna*

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**Medicinal properties and uses :** Leaves are anti-bilious and laxative and also useful in diseases of the skin and nervous system. The expressed juice is a demulcent, and is used in gonorrhoea (Nadkarni, 1954).

**Chemistry*** **:** In a preliminary study it was noted that there was considerable variation from batch to batch; the leaves yielded definitely more extractives. From the petroleum ether extract a new lactone was obtained easily on cooling and was named enhydrin. It crystallised from alcohol in colourless needles, m.p. 185-186°, molecular formula $C_{23}H_{28}O_{10}$ and had a methoxyl group. It had resemblance to sesquiterpene lactones of Compositae family. The spectra gave useful information about functional groups and certain skeletal parts. The presence of acetylenic compounds containing sulphur was also noted; they decomposed in the extraction process to yield elemental sulphur (Krishnaswamy *et al.*, 1968).

A more detailed study was made of enhydrin and a definite constitution proposed. The characteristic features were that besides an α-β-unsaturated lactone, three ester groupings were present; a carbomethoxyl, acetoxyl and epoxytigloyl and another epoxide group which was unreactive and germacranolide skeleton. In its reactions it resembled uvedalin. Its structure should be that of uvedalin epoxide. There was difference in m.p. between enhydrin and synthetic uvedalin epoxide. This could be attributed to demorphism or difference in epoxide orientation (Krishnaswamy *et al.*, 1971, 1972).

The revised structure of enhydrin was briefly reported (Krishnaswamy *et al.*, 1971) and subsequently a note appeared on the same subject in which same structure of enhydrin was given (Joshi *et al.*, 1971). Fuller details were given by Krishnaswamy *et al.* (1972).

Further a second sparingly soluble component was obtained from the light petrol extract as a minor component; m.p. 272-77°, $C_{20}H_{32}O_3$. It seemed to be a saturated hydroxylic compound with either a carboxyl or lactone grouping. Its chemical properties, spectra and transformations led to its identification as (—)-16-α-hydroxy-kauran-19-oic acid. It can be made by the hydration of the unsaturated acid, kaurenoic acid thus establishing interrelationship (Krishnaswamy *et al.*, 1969*a*, 1970).

After the separation of enhydrin, the mother liquor yielded a colourless product which after repeated column chromatography had m.p. 180-82° and composition $C_{20}H_{30}O_3$. It was identified as the deterpene, (—) kaurenoic acid (Krishnaswamy *et al.*, 1969*b*).

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*No report available on other aspects.

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## ENICOSTEMMA (Gentianaceae)

*E. LITTORALE* Blume (Syn. *Enicostemma hyssopifolium* (Willd.) Verdoorm.)

| | | | | | |
|---|---|---|---|---|---|
| Hind. | — | Chota-kirayat | Tam. | — | Vallari |
| Mar. | — | Kada-vinayi | Tel. | — | Nela-guli |
| Sans. and Ben. | — | Naagajivha | | | |

**Habitat :** Grows throughout India up to 5,000 m from Panjab and Gangetic plain to Ceylon.

**Parts used :** Whole plant.

**Medicinal properties and uses :** Whole plant is stomachic, bitter tonic, laxative and carminative. Dried powder is given with honey as a blood purifier and in dropsy, rheumatism, abdominal ulcers, hernia, swellings, itches and insect poisoning (Chopra *et al.*, 1956; Nadkarni, 1954).

**Chemistry* :** An alkaloid gentianine previously isolated from the plant has been found to be an artifact. Its precusor has been identified as swertiamarin. Extraction of the plant with methanol and chromatography of the extract over alumina

*No report available on other aspects.

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gave an amorphous bitter substance. Acetylation of this compound gave a crystalline acetate $C_{24}H_{30}O_{14}$, m.p. 194°. The NMR of this compound was found identifical with the published NMR spectrum of swertiamarin tetracetate. The identity was confirmed by direct comparison with authentic sample. The infrared spectra of the two samples were also identical (Govindachari *et al.*, 1966).

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## ENSETE (Musaceae)

*E. SUPERBUM* Cheesm

Eng. — Wild banana Hind. — Banakadali

**Chemistry :** The seeds of three varieties of wild banana *viz. Ensete superbum*, *Musa superba* and *Musa acuminata* have been claimed to have active principles with anti-smallpox activity. The seeds of *Musa acuminata* collected from Poona and flowers and fruits obtained from Delhi have been examined.

The petroleum ether extracts of the dried seed powder yielded fatty oil and triterpenoid esters. The subsequent aqueous methanol (50 : 50) extract on concentration and maceration with absolute methanol yielded a white solid which gave tests for proanthocyanidin and glucoside. Detailed study showed that it consisted of pro-pelargonidin glucosides of varying degrees of polymerisation.

A one year old sample of the seeds gave, in addition, a violet compound having the properties of pelargonidin colour base, but not identical with it. The flowers and fruits contained procynidin and prodelphinidin glucosides (Mahey *et al.*, 1971).

**Pharmacology :** All the three fractions (VIDR-2T, VIDR-2GC and VIDR-2GD) isolated from the seeds of *Ensete superbum* inhibited the growth of vaccinia and variola viruses on chick chorioallantoic membrane. In variola infected mice, they prevented the disease from appearing and significantly cured infected mice even when the drug treatment had begun at a late stage. $LD_{50}$ (intra peritoneally) of VIDR-2T was 174 mg./kg. while the other two *viz.* VIDR-2GC and VIDR-2GD were non-toxic to mice (Dutta *et al.*, 1968).

Fraction VIDR-2GD inhibited pregnancy in mice, rats, guineapigs, rabbits and hamsters. The drug had a pronounced antifertility effect in mice and rats. It was

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observed that if the drug was given in the period between fertilization of the ovum and the implantation of the zygote, the animals became infertile. Complete inhibition of pregnancy could not be achieved in rabbits. VIDR-2GD did not show any evidence of anti-estrogenic activity in doses in which it inhibited pregnancy in rats. At the same dose (1·0 mg.), it did not inhibit ovulation induced by copper acetate solution in adult female rabbits but in higher doses (5·0 mg.) it did inhibit ovulation.

The drug probably acted by preventing implantation of the fertilized ova. It seemed to possess weak anti-gonadotropic action. A large amount of VIDR-2GD could be ingested by mice and rats without any side effects (Dutta *et al.*, 1970*a*, *b*).

The fraction VIDR-2GD, in a dose of 100-150 mg./kg., caused prolonged and sustained hypotension in cats. Topical and intravenous administration of the drug produced congestion of the mesenteric blood vessels of rat and mice. Perfusion of the frog's vessels with the drug showed dilatory effect with increase in outflow. 30 mg./ml. of the drug caused immediate contraction of the ileum which was antagonised by atropine. The drug caused hypoglycaemia (15 per cent) at the end of 5th hour in a dose of 100 mg./kg. (Roy *et al.*, 1968).

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## EPHEDRA (Ephidraceae)

*E. NEBRODENSIS* Tineo. (Syn. *E. major* Host., *E. vulgaris* Rich., *E. gerardiana* Wall).

Eng. — Ephedra
Mar. — Huma
Punj. — Butshur

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*Alstonia scholaris*

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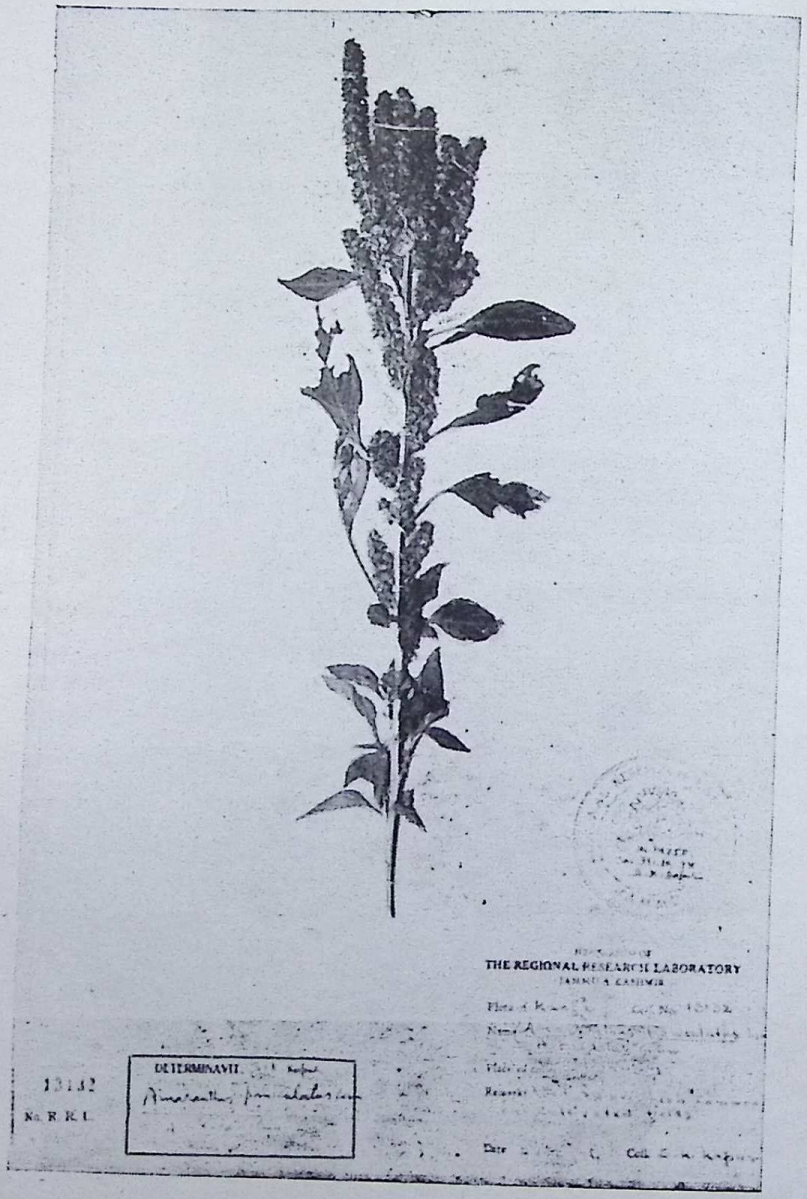


*Amaranthus caudatus*

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**Habitat :** The plant is scattered all over the world, found in western Himalayas, Afghanistan, western Tibet, Sikkim, Shalai hills and north of Simla. A number of species grow abundantly in the drier regions of the Himalayas. The Chinese Ephedras *viz. Ephedra pinica* and *E. equisetina* are imported in considerable quantities and contain much ephedrine (Nadkarni, 1954).

**Parts used :** Root and aerial parts.

**Medicinal properties and uses :** Root is used as an alterative, diuretic, stomachic and tonic. Ephedrine has the property of dilating the pupil of the eye. Its liquid extract is used for controlling asthmatic paroxysms. Tincture of ephedra is used as cardiac and circulatory stimulant. Decoction of stem and leaves is used as remedy for rheumatism and syphilis in Russia. Juice of berries is used in affections of respiratory passages (Chopra *et al.*, 1956; Nadkarni, 1954).

**Pharmacognosy :** Pharmacognostic studies of *E. nebrodensis* have been carried out.

Macroscopic characters : The stem is yellowish green with only one internode, fractured surface is fibrous in the cortex, but in pith shows brownish mass. Odour is agreeable, slighly aromatic and taste is astringent and bitter.

Microscopic characters : Epidermis is composed of rectangular to subrectangular cells with thick cuticle. Two types of fibres are found embedded in the above tissues, one, non-lignified hypodermal fibres in a group of 2 to 15 and forming cone-shaped area and the other mesocortical lignified fibres scattered throughout the region either singly or in a group up to 15. Microcrystals of calcium oxalate in the form of prisms are found throughout the cortex. All the fibres are septate and vascular bundles are 8 to 11 in number and arranged in a single ring. Starch is absent (Shah and Shah, 1966).

**Chemistry :** Two methods for the estimation of total alkaloids in tincture of Ephedra have been described. The first method is based on the principle of precipitation of the alkaloid with an acid and then titration of the excess acid with an alkali. The second method also involves a titration but the precipitation of the alkaloid is done with lead acetate solution and the excess lead in the solution precipitated with sulphuric acid and further titration with an alkali (Srivastava *et al.* 1958).

A method for the extraction of total alkaloids of *Ephedra* based on the use of ultrasonic energy and subsequent estimation by the pharmacopoeial method has been described (Seth and Sarin, 1970).

Estimation of total alkaloids in *E. nebrodensis* by I.P. method was found to be 1·3 per cent. TLC study showed two ninhydrin positive spots of which one corresponded to ephedrine (Shah and Shah, 1966).

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## ERUCA (Cruciferae)

*E. SATIVA* Mill.

| | | | |
|---|---|---|---|
| Ben. | — Shwet sursha | Mar. | — Jambho |
| Hind. | — Safed sarson | Sans. | — Siddartha |

**Habitat:** An annual or biannual herb, cultivated as a field crop in Uttar Pradesh and Madhya Pradesh and Sind for the oil expressed from the seed. This is a variety of mustard.

**Parts used :** Seeds and leaves.

**Medicinal properties and uses :** Seeds are acrid and used like mustard. Leaves are stimulant, stomachic, diuretic and antiscorbutic (Chopra *et al.*, 1956; Nadkarni, 1954).

**Chemistry :** The seeds of plants belonging to Cruciferae generally contain thio-glucosides. A phytosterol, m.p. 136-137° has been isolated from the oil of the seeds. An alkaloid has also been isolated from the alcoholic extract of the steam distilled and defatted seeds (Gaind and Sobti, 1963).

**Pharmacology :** The oil of the seeds was found to have anti-bacterial activity against gram positive as well as gram negative organisms. Phytosterol isolated from the plant also possessed anti-bacterial properties. On comparing the anti-bacterial activity with penicillin on *Staphylococcus aureus*, it was found that 5 per cent solution of phytosterol had the same activity as 2·5 units of penicillin. Against *Shigella shigae* and *Shigella flexneri*, the activity was equivalent to 1 per cent suspension of sulpha-guanidine (Gaind and Sobti, 1963).

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*Eruca sativa*

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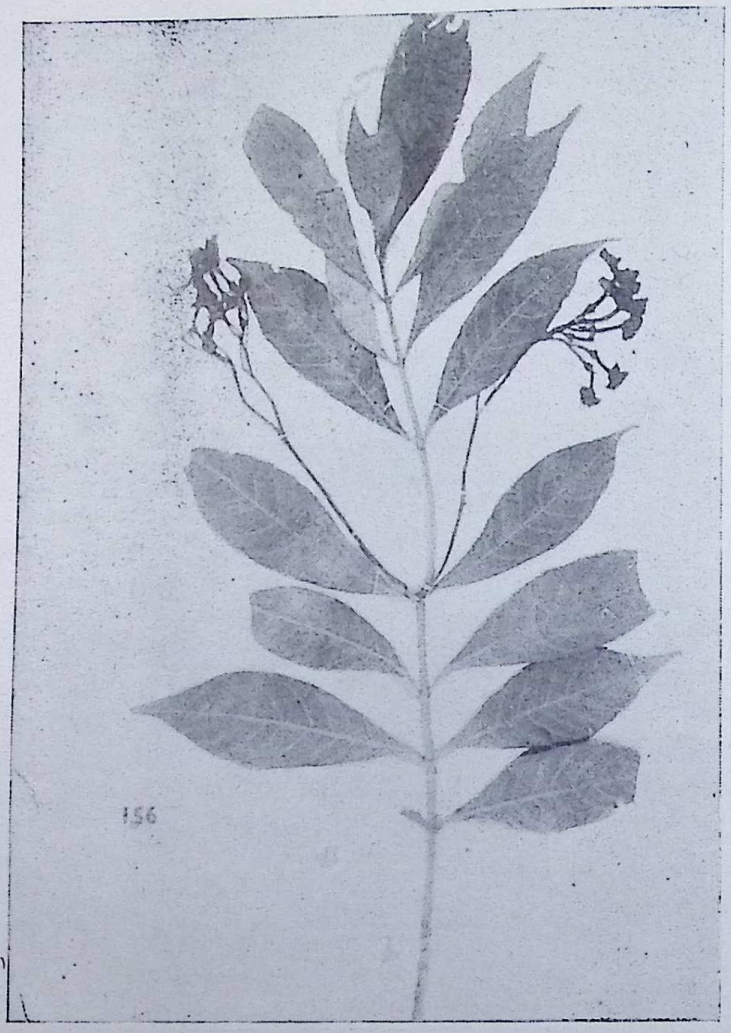


*Ervatamia coronaria*

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**Reference**

Gaind, K.N. and Sobti, S.L. 1963. Antibacterial principles of *Eruca sativa* (seeds). **RRL Bulletin 1**, 197.

## ERVATAMIA (Apocynaceae)

*E. CORONARIA* Stapf. (Syn. *Tabernaemontana coronaria* Br.)

| | | | |
|---|---|---|---|
| Ben., Hind., Mar. and Sans. | — Tagar | Tam. | — Nandiyaavattai |
| | | Tel. | — Gandhitagarapu |

**Habitat :** Found in upper gangetic plain, Garhwal, east Bengal, Khasia hills, Assam, northern Circars, and hills of Vizagapatnam. Also cultivated in gardens as an ornamental plant.

**Parts used :** Wood, milky juice, root and stem-bark

**Medicinal properties and uses :** Wood is a refrigerant. Milky juice is used for diseases of eye. Root is acrid and bitter, used as local anodyne and chewed for relief of toothache (Chopra *et al.*, 1956).

**Pharmacognosy :** Pharmacognostic studies have been carried out on the root of *E. coronaria*.

Macroscopic characters : The roots are cylindrical, outer surface is finely wrinkled longitudinally and covered by a thick layer of pale greyish cork. Fracture is short and taste acrid-bitter.

Microscopic characters : Cork is composed of 8-14 rows of suberized and lignified cells, phellogen is indistinct and phelloderm of 8-18 layers of thin walled oral or rounded parenchyma cells with numerous starch grains. Prisms or microcrystals of calcium oxalate are present. Latex ducts are long and of non-articulate type. Xylem is broad, occupying almost three-fourths of the diameter of the root. Powdered root is pale yellow and under the microscope shows the presence of starch grains, fragments of latex ducts and a few crystals of calcium oxalate (Madan and Nayar, 1960).

**Chemistry and Pharmacology :** A bacteriolytic enzyme isolated from the latex of *E. coronaria* was purified by negative adsorption chromatography over carboxymethyl cellulose and eluted by sodium chloride of increasing molarity. The enzyme eluted from carboxymethyl cellulose could be freed from sodium chloride by

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gel filtration through sephadex-50. The enzyme was free from amylolytic, proteolytic and β-glucosidic activity. Optimum pH on *Micrococcus lysodeikticus* cells was around 4. A heated extract of the crude latex was also found to be a potent inhibitor of purified enzyme (Kidwai and Krishnamurti, 1963).

The action of the purified lytic enzyme has been studied on bacterial cells and isolated cell wall. The enzyme produced lysis in hypophilised cells of *M. lysodeikticus*, *B. megatherium*, *Sarcina lutea* and *E. coli*. The mechanism of action of the plant enzyme has a close resemblance to the *Stryptomyces* lytic complex (Kidwai and Krishnamurti, 1964).

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## ERYNGIUM (Umbelliferae)

*E. CAERULEUM* Bieb.

Hind. — Dudhali  Urdu — Salelimisri
Punj. — Pahari gajar

**Habitat :** Grows in western Himalayas at 2,000 m.

**Parts used :** Root

**Medicinal properties and uses :** Roots are used as nervine tonic and as aphrodisiac. The ashes of the plants are useful in haemorrhoids. The roots are expectorant, diuretic and diaphoretic and are considered to be haematinic. In the Unani System of medicine, the plant is used as tonic and stimulant (Chopra *et al.*, 1956).

**Pharmacognosy* :** The roots of *E. caeruleum* are commonly adulterated with the roots of an allied species *E. billardieri*. The pharmacognostic investigations of both these species were carried out to distinguish one from the other.

*No report available on other aspects.

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*Eryngium billardieri*

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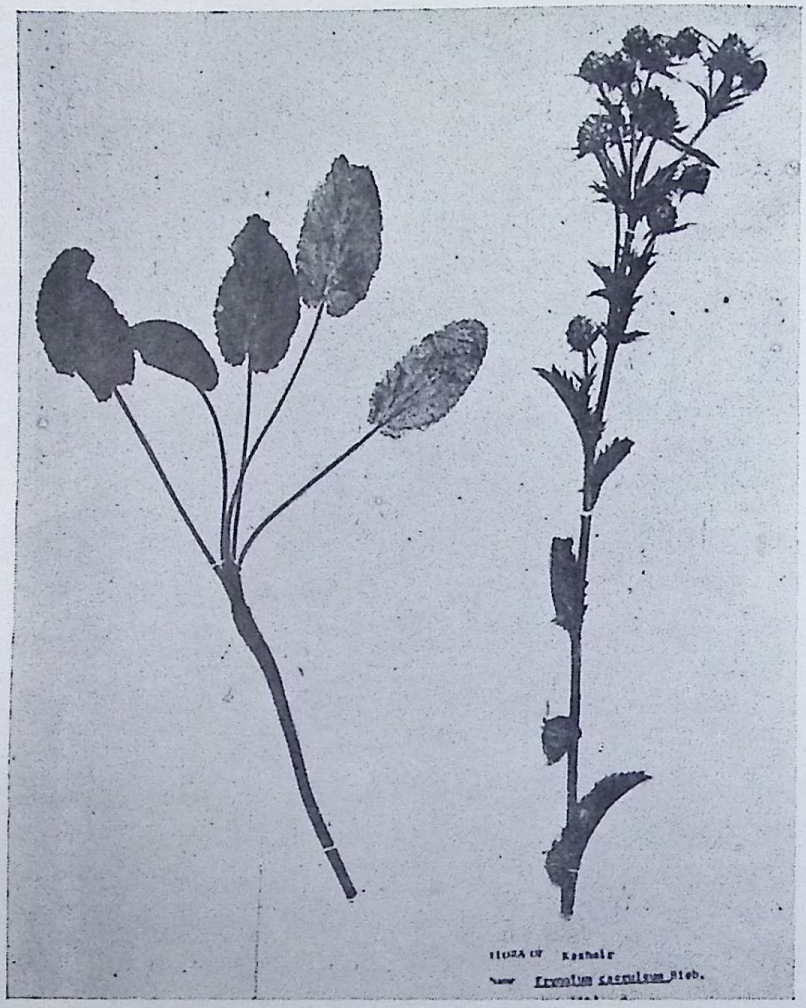


*Eryngium caeruleum*

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Both these plants are spinescent, erect, perennial herbs. The radical leaves of *E. billardieri* are few while cauline leaves are 3-5 partite. In *E. caeruleum*, both radical and cauline leaves are undivided.

Microscopically both the species have almost similar structure in root, stem and leaf. Secretory canals are seen in the secondary phloem and secondary cortex of roots, but in the latter region they are smaller in size and relatively inconspicuous. Cluster crystals of calcium oxalate are abundant in the parenchyma cells. The stem structure is normal. Patches of collenchyma are present at regular intervals beneath which secretory canals are located. The ring of vascular bundles are connected by patches of xylem fibres. The leaf petiole shows an arc-like wavy outline with well developed collenchymatous patches on the lower side in *E. billardieri*, while in other species it is not wavy. Vascular bundles are 7-12 in number and arranged in an arc. Between the vascular bundles lysigenous cavities are seen. The leaves are isobilateral but in *E. caeruleum* the leaf becomes dorsiventral upwards. Stomata are of anisocytic type and are present on both surfaces in *E. billardieri* and only on lower side in *E. caeruleum*. Various leaf values like palisade ratio, stomatal index, stomatal number, vein-islet number and veinlet termination number together with ash values, fluorescence characters and preliminary phytochemical studies have been worked out (Raina, 1974).

### Reference

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## ERYTHRINA (Leguminosae)

*E. INDICA* Lam. (Syn. *E. stricta* Roxb., *E. corallodendron* Linn.)

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Palita-madar | Kon. | — | Pangiro |
| Eng. | — | Indian coral tree | Mal. | — | Mooloomogrikah |
| Guj. | — | Panarawas | Mar. | — | Pangara |
| Hind. | — | Ferrud, mandar | Tam. | — | Kaliyana murungai |
| Kan. | — | Haarawaana | Tel. | — | Barijamu |

**Habitat :** A tree, common in Bengal and many parts of India specially in southern India ; often grown in gardens as a support for black-pepper vines.

**Parts used :** Bark, juice and leaves.

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**Ayurvedic description**

Sanskrit : *Mandaara*

Synonyms : *Paaribhadraka, paarijaata, karnikaara, palaashapatra, swalpakantakee, paadotpala, katakeepaarijaata, kantakimshuka, raktakusuma, nimbadruma, sashimbu.*

Properties : *Rasa* — *Katu* (*tikta* ?)
*Guna* — *Laghu*
*Veerya* — *Ushna*
*Vipaaka* — *Katu*

Actions/Uses: General — *Arochakahara, deepanee, shothahara, mehaghna, krimighna.*

Leaves and flowers — *karnavyaadhivinaashana, pittarogaghna*

**Medicinal properties and uses :** Bark is antibilious, expectorant, febrifuge and anthelmintic. Juice is vermifuge and cathartic. Leaves are diuretic, laxative, emmenagogue and glactogogue. In its action erythrine, the alkaloid, is antagonistic to strychnine and may be used as an antidote to strychnine poisoning (Nadkarni, 1954).

*E. SUBEROSA* Roxb.

Hind. — Pangra
Kan. — Kaaduhaarivaana
Punj. — Thab
Tam. — Mullumurungai
Tel. — Bariyama

**Habitat :** Grows in Punjab plains, upper gangetic plain, central and south India. Often planted as an ornamental and fence plant (Chopra *et al.*, 1956).

**Parts used :** Bark

**Pharmacognosy:** The macro and microscopic characters of the bark of *E. variegata* var. *orientalis* have been described. Bark has no taste and is odourless. The cork comprises about 25 layers of cells with a narrow cortex. The phloem has sieve tubes, companion cells, groups of phloem fibres, medullary rays, phloem parenchyma and secretory cells. Prickles on maceration show several sclereids. The powder shows sclereids, fibres, patches of cork cells, fragments of sieve tubes, medullary ray cells, parenchyma cells, a little free starch, prisms of calcium oxalate and fragments of lignified tracheary elements, under the microscope (Bisht and Nayar, 1959).

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**Chemistry :** Isolation and characterisation of a new alkaloid erythrascine and a tetrahydrobenzyl isoquinoline alkaloid from seeds of *E. arborescens* has been reported. In addition, 10 spiroamine erythrina alkaloids and hypaphorine previously reported in other *Erythrina* species were also isolated from the plant (Ghosal *et al.*, 1972).

Successive extraction of the air-dried powdered bark of *E. indica* with ethanol and petroleum ether followed by chromatography over alumina yielded seven colourless crystals, three of which were identified as β-sitosterol, γ-sitosterol, and δ-sitosterol. The other compounds have not been identified (Bhakuni and Khanna, 1959*a*).

From the seeds of *E. variegata* var. *orientalis* two crystalline fractions erythraline and 'free' and 'liberated' erysovine have been isolated. The fatty acid composition of the seed oil has also been determined (Singh and Chawla, 1970*a*).

From the trunk bark of *E. variegata*, a crude alkaloid mixture was obtained which was purified by gradient extraction and chromatographic adsorption. Four alkaloids were separated from the total alkaloidal mixture (0·11 per cent), *viz.* erysodine, $C_{10}H_{21}NO_3$, erysovine, $C_{18}H_{21}NO_3$, erysonine, $C_{17}H_{19}NO_3$ and hypaphorine, $C_{14}H_{18}H_2O_3$. They were all identified by mixed m.p., UV, IR, *etc.* A new alkaloid erysotrine, $C_{19}H_{23}NO_3$ was also isolated in the from of a pale brown, syrupy liquid. The leaves contained total alkaloids 0·035 per cent; from which erysotrine, erysodine, and erythraline hydrochloride were identified. The seeds contained total alkaloid 0·082 per cent from which hypaphorine, erysopine $C_{17}H_{19}NO_3$ and a new compound erysotine $C_{17}H_{21}NO_4$ have been identified. The above data indicated a structural relationship in erysopine-erysotine pair similar to that existing between erythraline-erythratine (Ghosal *et al.*, 1970).

A new alkaloid with molecular formula $C_{30}H_{36}O_5N_4$ provisionally named erythrinine has been reported in *E. lithosperma*, containing four O-$CH_3$ groups and one CO-NH group. All the N-atoms were present in the ring system (Tandon *et al.*, 1969).

The air-dried powdered bark of *E. lithosperma* was defatted with petroleum ether and then extracted with alcohol. The concentrated alcoholic extract was purified by column chromatography over alumina. From the different eluents, 6 alkaloids have been isolated *viz.* erysodine, m.p. 204-5°, erysovine, m.p. 178°, erythramine, $C_{18}H_{21}O_3N.HI$, m.p. 248°, erythraline, m.p. 106°, erythralinone, m.p. 118° and hypaphorine, m.p. 257°. UV, IR and NMR spectra have been utilized for the identification of the alkaloids (Majumdar and Ghosh, 1971).

From *E. lithosperma*, the alkaloids N-norprotosinomenine, protosinomenine, erysopine, erythraline, erythramine, erysodine, erysotryptophan and hypaphorine were identified. The occurrence of the first three of these alkaloids have not been previously recorded in nature (Ghosal *et al.*, 1971).

Study of the constituents of *E. suberosa* showed that the unsaponifiable fraction of the petroleum ether extract of the seeds yielded β-sitosterol. The alcoholic

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extract of the defatted seeds gave three nitrogenous entities, one of which was water soluble. The experimental data favoured the identity of the water-soluble alkaloid as erysodine (Singh and Chawla, 1968). The seeds further yielded three alkaloids *viz* erysodine, erysotrine and hypaphorine. The solid mass crystallised as erysodine. The syrupy residue gave erysotrine while the aqueous layer gave hypaphorine. This is the first time that erysotrine has been found to occur naturally although it is well known as a conversion product of other erysoalkaloids (Singh and Chawla, 1969).

The alkaloidal constituents were found to vary in different seed collections of *E. suberosa*. The unsaponifiable matter of the seed oil showed sitosterol, stigmasterol, campesterol and cholesterol (Singh and Chawla, 1970*b*).

The petroleum ether extract of the bark of *E. suberosa* was fractionated into wax esters, wax alcohols and acids, alkyl ferulates, stigmasterol, campasterol and cholesterol (Singh and Chawla, 1970*c*).

The leaves of *E. suberosa* yielded an intractable chloroform-soluble base and a water-soluble base identified as hypaphorine (Singh and Chawla, 1971).

**Pharmacology :** The total alkaloids isolated from the stem bark of *E. variegata* showed a weak spasmolytic and relaxant action on smooth muscles of guineapig ileum, rat lieum and rat uterus. The relaxant effect on isolated rabbit ileum and rat uterus was found to be a direct one and it was not antagonised by adrenergic blocking agents. The alkaloids showed a curarimimetic action on skeletal muscles (frog's rectus abdominis muscle and rabbit head drop method) by both *in vitro* and *in vivo* tests. The potency was 10-20 times less than that of d-tubocurarine. The alkaloids produced moderate increase in bile secretion. They also produced depression of CNS in rats and showed anticonvulsant effect against both metrazol and electroshock-induced convulsions in rats. $LD_{50}$ of the drug was found to be 87·5 mg./kg i.p. in albino rats (Bhattacharya *et al.*, 1971).

The alcoholic extract of the leaves of *E. suberosa* showed anti-cancer activity against sarcoma 180 in mice. The alcoholic extract of the stem bark of the same plant was found to have hypoglycaemic activity in albino rats (Dhar *et al.*, 1968).

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## ERYTHROXYLUM (Erythroxylaceae)

*E. MONOGYNUM* Roxb.

| | | | | | |
|---|---|---|---|---|---|
| Kan. | — | Devadaru | Tam. | — | Devadaru, chemanatti |
| Mal. | — | Devataru | Tel. | — | Devadaru |

**Habitat :** Found in Deccan and Karnataka in dry evergreen forests, western ghats, in dry hill forests of Travancore up to 1000 m.

**Parts used :** Leaves, wood, bark and oil.

**Medicinal properties and uses :** Infusion of wood and bark is stomachic, diaphoretic, stimulant, diuretic and is useful in mild cases of dyspepsia and continued fever. Leaves are refrigerant (Chopra *et al.*, 1956).

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**Chemistry*** : The total composition of diterpene hydrocarbons isolated from *E. monogynum* showed the following : (+)—hibaene (74 per cent); (—) pimaradiene (6 per cent) and three new naturally occurring diterpenes, now designated as (—) —atisirene, (—)—isoatisirene and (+)—devadarene. From the low end-absorption in the UV, it was clear that atisirene $C_{20}H_{32}$, m.p. 57-58° had only one ethylenic linkage and consequently must be tetracyclic; isoatisirene $C_{20}H_{32}$, m.p. 84-85° and devadarene, $C_{20}H_{32}$, b.p. 140-48° (bath/2 mm.) showed the presence of three vinyl protons.

The biogenetic considerations have also been taken into account. The hypothesis presented showed that absolute stereochemistry of the various constituents must be the same at a common reference point (Kapadi *et al.*, 1965).

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## EUCALYPTUS (Myrtaceae)

*E. CITRIODORA* Hook.

Tel. — Talanoppi

**Habitat :** Planted in the plains of north India and in the mountainous tracts. Also grown in Malabar, the Nilgiris and Coorg.

**Parts used :** Leaves.

*E. GLOBULUS* Labill.

Eng. — The Australian gum tree
Tam. — Karpooramaram
Mal. — Karpuramaram

**Habitat :** A native of Australia now being cultivated on the highlands of India, chiefly on the Nilgiris.

*No report available on other aspects.

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**Parts used :** Dried leaves, gum exudation from the stem and oil distilled from the fresh leaves.

**Medicinal properties and uses :** Leaves are febrifuge and carminative, stimulant, expectorant, diaphoretic and antiseptic. Anti-malarial properties are attributed to the volatile oil. Eucalyptus oil is a powerful antiseptic and disinfectant.

Eucalyptus increases the flow of saliva, gastric and intestinal juices and thus increases appetite and digestion. It increases the rate of heart beats, lowers the arterial tension and quickens respiration. It is eliminated by the skin, kidneys and lungs and thus found in perspiration, urine, breath, milk *etc.* In large doses it is an irritant of the alimentary canal producing eructation, indigestion, nausea, vomiting and purging. In toxic doses it is a narcotic poison. It paralyses the respiratory centre in the medulla. Oil obtained from Indian sps. does not contain butyric and valerinic aldehydes; it is less likely to produce cough and other unpleasant side effects (Nadkarni, 1964).

**Pharmacognosy :** Macroscopic and anatomical characters of the juvenile as well as the mature leaves of four species of *Eucalyptus* have been described. In *E. globulus*, leaves are bifacial, lanceolate, scythe-shaped, glabrous, sessile, thin and wax coated; Microscopically, there is seen a coating of wax over and above the thin cuticle, stomata of ranunculaceous type are present on lower surface only and few round internal oil glands are present, and calcium oxalate crystals of prismatic and rosette type are also seen.

*E. rostrata* leaves are bifacial, lanceolar, sickle-shaped, coriaceous, petiolate, glaucous, ovate with distinct venation. Cuticle is papillate, stomata are of ranunculaceous type found on both the surfaces; many oil glands are present as also rosette crystals.

In *E. viminalis*, leaves are bifacial, elongate or falcate-lanceolate, glabrous, glaucous and sessile. Thick cuticle with minute papilla in upper and marked in lower surface are present; stomata are ranunculaceous, present on both the surfaces and oil glands are also present. Both types of crystals, prismatic and rosette are present. *E. polyanthemos* leaves are bifacial, coarse, orbicular, intramarginal. Both cuticles are less thickened and stomata are present on both the surfaces. Oil glands are present and crystals of both the types are found. Quantitative studies have also been conducted in all the species (Datta and Datta, 1952).

**Chemistry :** A detailed and systematic investigation has been made on this plant employing modified extraction procedures. Besides the earlier reported dihydroflavonol, aromadendrin-7-methyl ether, para-coumaric acid has been found to be present. The tanning property of the plant has been found to be due to the occurrence of large amounts of gallotannins. The antibacterial component has also been now identified as the methyl ester of p-coumaric acid. The identity was established by mixed melting point and by infrared spectral comparison. Cinnamic acid was also

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isolated after hydrolysis which indicated that it might be present in a combined form (Parthasarthy, 1964).

**Pharmacology :** Out of the 4 chemical components *viz.* 7-methyl-kaempferol, 7-methyl-aromadendrin, ellagic acid and citriodorol isolated from *E. citriodora*, only citriodorol showed significant anti-tubercular activity against *M. tuberculosis* ($H_{37}R_v$ strain) *in vitro* (Ramaswamy and Sirsi, 1966).

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## EUGENIA (Myrtaceae)

*E. JAMBOLANA* Lam. (Syn. *Syzygium jambolanum* DC.)

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Kala-jam | Kon. and Mar. | — | Jambul |
| Eng. | — | Jambul, black plum, black berry | Mal. | — | Naval |
| Guj. | — | Jambudo | Tam. | — | Nagum, naagamaram |
| Hind. | — | Jaman, phalinda | Tel. | — | Nalraedu |
| Kan. | — | Neralay | | | |

**Habitat :** Grown throughout the plains from Himalayas to south India.

**Parts used :** Fruit, leaves, dried seeds and bark.

**Ayurvedic description**

Sanskrit : *Jamboo*

Synonyms : *Mahaaphala, bahubhadra, surabhipatra, neelaphala, shyaamala, raaja-jamboo, mahaajamboo*

Properties : *Rasa* — *Kashaaya, madhura, (amla ?)*
*Guna* — *Laghu, rooksha*
*Veerya* — *Sheeta*
*Vipaaka* — *Madhura*

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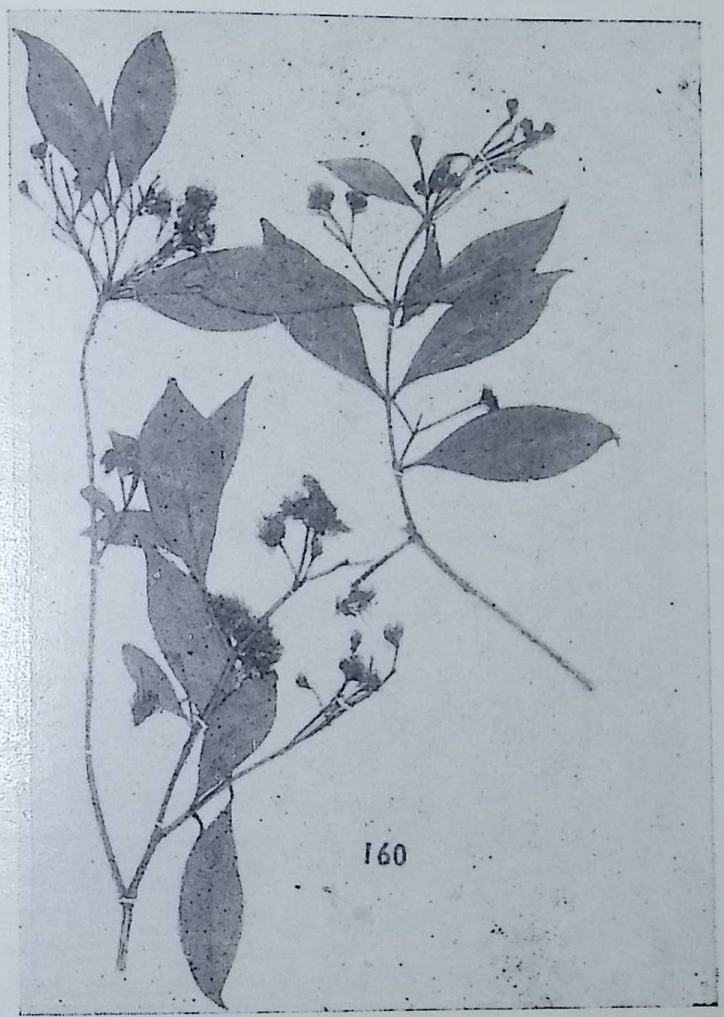


*Eugenia jambolana*

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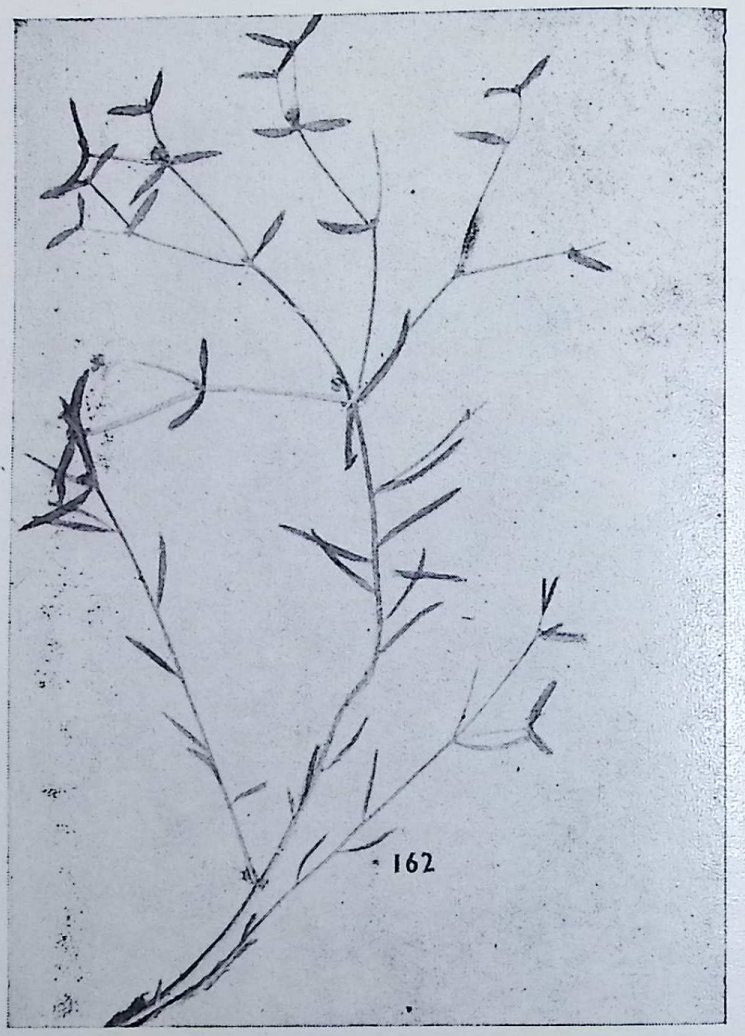


*Euphorbia dranunculoides*

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Actions/Uses: General : *Graahi, ruchya, paachanee, veeryaprada, pushtikara, balaprada, hritkanthagharshana, shramaapaha, daahaghna, kantharogaghna, shoshahara, krimidoshahara, shwaasa-shamana, ateesaaraghna, kaasaghna, swarakaree, vishtam-bhashamaneeya, raktapittahara.*

Seeds : *Madhumehaghna*

**Medicinal properties and uses :** Bark, leaves and seeds and fruits are astringent. Juice of the fruit is stomachic, astringent, diuretic and antidiabetic (Nadkarni, 1954).

**Chemistry :** Two triterpene acids, oleanolic acid and crategelic acid (maslinic acid) were isolated from the flowers of *E. jambolana*, as their respective methyl esters (Sengupta and Das, 1965).

Friedelin, epi-friedelinol and betulinic acid as its methyl ester were common in both the species *viz. E. fruticosa* and *E. wallichii*. β-sitosterol has been isolated only from the bark of *E. wallichii* (Majumdar and Thakur, 1968).

**Pharmacology :** Fresh powdered seed of *E. jambolana* was found to lower the level of blood sugar in diabetic rabbits (Vaish, 1954). The fruit and seeds were found to be promising hypoglycaemic agents (Aiman, 1961). The aqueous extract of seeds of the plant produced 15 to 25 per cent fall in fasting blood sugar in four to five hours after giving a single dose orally (Shrotri *et al.*, 1963).

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## EUPATORIUM (Compositae)

*E. AYAPANA* Vent.

| | | | |
|---|---|---|---|
| Guj. | — Allipa | Kon. | — Ayapanum |
| Hind. Ben., and Mar. | — Ayapana | Tam. and Tel. | — Aayapannai |

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**Habitat :** A native of Brazil, cultivated in various parts of India in damp places, meadows and river-banks.

**Parts used :** Whole herb.

**Medicinal properties and uses :** The whole herb is used as a bitter tonic, expectorant, diaphoretic and antiperiodic. In higher doses it is an aperient given in derangement of the stomach and bowels, dyspepsia, cough and ague. Hot infusion is given in the cold stage of ague and in the state of depression preceding the acute inflammatory affections. It may be compared with chamomile in its effects. In small doses it is stimulant and tonic. It has also antiscorbutic and alterative properties. Fresh bruised leaves are applied to foul ulcers, sores and to bites of venomous reptiles. Internally, the drug is given as an antidote to snake-bites. Infusion when used in the cholera epidemic of Mauritius was found valuable in restoring the warmth of surface, languid circulation *etc.* (Nadkarni, 1954).

**Pharmacognosy* :** The salient features of the herb have been described.

Macroscopic characters : The stem is herbaceous with simple, slippery leaves having slightly aromatic odour.

Microscopic characters : The stem in transection shows epidermal cells which are barrel shaped; stomata are few in number, each surrounded by five cells; covering trichomes are few. The cortex has big intercellular spaces and few starch grains. Pericycle consists of small groups of fibres, connected by broad strips of thin-walled parenchyma cells. Few crystals of calcium oxalate are present.

Leaf lamina in transaction shows an undulate outline with prominent convexities on its lower surface representing midrib and smaller vein regions. The average vein-islet number for the leaves varied from 3·4 to 3·9 and palisade ratio from 2 to 3·5. The average number of stomata per unit area on lower epidermis varies from 138 to 166 and on the upper epidermis from 38 to 40. The stomatal index calculated from lower surface varies on the average from 17 to 20 and on the upper surface from 5 to 6.

The midrib shows an abaxial hump of hypodermal collenchymatous cells. The cells of both the upper and lower epidermis are rounded and thick walled. The mesophyll has a broad crescent shaped meristele embedded in parenchyma and consisting of many narrow collateral bundles. Besides the main vascular tissue, there are two minute subsidiary strands. Phloem has few starch grains (Chaudhury and Datta, 1950).

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*No report available on other aspects.

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**Reference**

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## EUPHORBIA (Euphorbiaceae)

*E. ANTIQUORUM* Linn.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Narsij | Mal. | — | Chaturkalli |
| Eng. | — | Triangular spurge | Mar. | — | Tridhari |
| Guj. | — | Tandhari | Sans. | — | Vajratundi, vajrakantaka |
| Hind. | — | Tidhara | Tam. | — | Chadurakkali, ilaikalli |
| Kan. | — | Kalli | Tel. | — | Bommajemudu |
| Kon. | — | Nivali | | | |

**Habitat :** A small tree commonly grown in India.

**Parts used :** Juice from the stem, root and root-bark.

**Medicinal properties and uses :** The juice is purgative, emetic, alterative, stomachic rubefacient and vesicant (Nadkarni, 1954).

*E. HIRTA* Linn. (Syn. *E. pilulifera* Linn.)

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Baro-kheruie | Mar. | — | Nayeti |
| Hind. | — | Dudhi | Sans. | — | Amampatchaiarisi, |
| Mal. | — | Nelapalai | Tam. | | patchaiyarissi |

**Habitat :** Found throughout the hotter parts of India.

**Parts used :** Whole plant.

**Medicinal properties and uses :** Entire plant is used in diseases of children *i.e.* in worms, bowel complaints, cough *etc.* Juice of plant is used in dysentery and colic. Decoction of plant is beneficial in bronchial affections and asthma. Latex of plant is used as application for warts (Chopra *et al.*, 1956; Nadkarni, 1954).

*E. LATHYRUS* Linn.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Burg-sadab | Punj. | — | Sudab |

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**Habitat :** A native of central and south Europe and now found in hotter parts of India.

**Parts used :** Leaves, seeds and capsules.

**Medicinal properties and uses :** Leaves are carminative while seeds are used in dropsy; capsules are used to intoxicate fish (Chopra *et al.*, 1956).

*E. ROYLEANA* Boiss.

Hind. and Ben. — Thor, Shakarpitan
Punj. — Dandathor

**Habitat :** Found in outer dry slopes of western Himalayas chiefly at 1000 to 1650 m. Commonly grown in sub-Himalayan tracts and adjacent plains.

**Parts used :** Milky juice and entire plant.

**Medicinal properties and uses :** Milky juice is an anthelmintic and cathartic (Chopra *et al.*, 1956; Nadkarni, 1954).

*E. TIRUCALLI* Linn.

Ben. — Lankasij
Eng. — Milk-hedge
Guj. — Thora danadalio
Hind. — Barki-thohar
Kan. — Mondukalli
Kon. — Baddinivali
Mal. — Tirukalli
Mar. — Kadanivalli
Sans. — Dugdhika, trikantaka
Tam. — Kalli, tirukalli
Tel. — Kadajamudi

**Habitat :** This plant is a native of America but has become acclimatised and grows freely in all parts of India.

**Parts used :** Milky juice and bark.

**Medicinal properties and uses :** Milky juice in small doses is a purgative but in large doses it is acrid, counter-irritant and emetic. Externally it is rubefacient and used as fish-poison (Nadkarni, 1954).

**Chemistry :** Two triterpenoids *viz.* taraxerol and epi-friedalanol were isolated as acetates from the benzene extract of the stem bark of *E. antiquorum* (Sengupta and Ghosh, 1964).

From the stem bark of *E. antiquorum*, friedalen—3α-ol and its β-isomer, taraxerol and taraxerone have been isolated and identified. Taraxerol has also been found in the roots (Anjaneyulu *et al.*, 1967).

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*Euphorbia hirta*

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*Ferula jaeschkeana*

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From *E. antiquorum* latex, β-amyrin, cycloartanol, euphol and α-euphorbol were isolated and identified. Cycloartanyl acetate was converted into parkeol by bromination at room temperature with bromine and acetic acid to a new dibromoacetate which on debromination furnished parkeol acetate. In another method, cycloartanyl benzoate was treated with chloroform-HCl and the resulting hydrochloride on hydrolysis furnished parkeol. Cycloartanyl acetate was also converted into agnasterol (Anjaneyulu and Rao, 1971).

The commercial latex of *E. caltimandoo* was found to contain euphol, nerifoliol and euphorbol, while the stem contained taraxerol only (Anjaneyulu *et al.*, 1969).

To study the changes in proteins during humification, proteins from the leaves of *E. hirta* in organic matter, soil treated with leaves and soil from uncultivated land were extracted by different solvents. Results showed that decomposition of total ethanol-soluble proteins was maximum in all the three cases. Decomposition of total proteins was greater in the case of treated soil as compared to organic matter and other soil. This emphasized the role of micro-organisms which developed in the soil during humification. The rate of protein breakdown increased with increasing rate of decomposition of carbohydrates (Tandon *et al.*, 1964).

The organic compounds present in *E. hirta* and *E. thymifolia* have been isolated and the structure has been studied. Acids were not present in the free state but were associated with inorganic cations to form salts, or they were converted into some other acids during Kreb's cycle (Gupta and Garg, 1965).

Petroleum ether and ethanol extracts of the stem of *E. hirta* on chromatography yielded myricyl alcohol, taraxerol, friedelin, β-sitosterol, hentriacontane and β-amyrin. The ethanol extract of the flowers of the same plant gave only ellagic acid. The above compounds were identified by their physical and chemical properties and by the preparation of their derivatives (Gupta and Garg, 1966).

From the seeds of *E. lathyris*, 6, 20-epoxy-lathyrol, phenylacetate-diacetate and from the leaves β-sitosterol were isolated. Hentriacontane, taraxerone, β-sitosterol, taraxerol and betulin could be obtained from the stem (Dutta and Chakravati, 1971).

From the leaves of *E. longana*, friedelin, 16-hentriacontanol, epifriedelinol, β-sitosterol, stigmasterol and stigmasteryl D-glucoside were isolated (Mahato *et al.*, 1971).

Taraxerol has been isolated from the petroleum ether extract of the stem and ellagic acid from the ethanol extract of the flowers of *E. royleana* (Sharma *et al.*, 1964).

Glut-5-en-β-ol, m.p. 206-208°, was isolated for the first time from a natural source. Besides this, the isolation of other triterpenoids from the stem of *E. royleana* was also reported (Sengupta and Ghosh, 1965).

The stem of *E. tirucalli* has been found to contain hentriacontane, hentriacontanol, β-sitosterol, taraxerol, 3, 3′-di-o-methyl-ellagic acid, ellagic acid and also furnished kaempferol and glucose (Gupta and Mahadevan, 1967).

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**Pharmacology :** The water soluble fraction of the 90 per cent ethanolic extract of the whole plant *E. dranunculoides* showed two types of activities, cholinergic and direct action on different muscle preparations. Acetylcholine-like action with muscarinic as well as nicotinic activities was found on isolated ileum of rabbit, guineapig and rat, tracheal chain of dog, blood pressure of dog and frog's rectus muscle preparation. The acetylcholine-like principle was found to be susceptible to cholinesterase activity. A direct action was manifested on isolated uterus of rat, guineapig, rabbit, human being and dog *in situ* (Prasad *et al.*, 1967).

The latex of *E. neriifolia* in distilled water produced a persistent rise in blood pressure of dog in a dose of 0·1 ml./kg. i.v. This dose potentiated the responses of adrenaline and carotid occlusion but partially blocked those of isoprenaline and acetylcholine. In a higher dose (0·2 ml./kg.) there was no change or a fall in blood pressure after an initial rise. It produced manifold increase in the rate of respiration in dogs both on intravenous and intracerebroventricular administration. Still higher doses produced apnoea. On isolated guineapig ileum, repeated doses of the latex produced tachyphylaxis of the stimulant action. These doses also blocked the response of 2·5 mcg./ml. of histamine. On isolated rabbit ileum, after an initial stimulation, it blocked the response to acetylcholine (Iqbal *et al.*, 1969).

The alcoholic extract of entire plant *E. hirta* showed anti-cancer activity against *Friend virus leukemia* (solid) in mice. Hypoglycaemic activity was observed in albino rats with the extract. The extract also possessed antiprotozoal activity against *Entamoeba histolytica* which was also seen in the extract of the aerial parts of *E. tirucalli.* The alcoholic extracts of entire plant *E. prolifera* and stem of *E. royleana* possessed antiviral activity against *Ranikhet disease virus.* Anti-cancer activity of the alcoholic extract of *E. procera* (whole plant) was seen against *Walker carcinosarcoma* 256 (intramuscular) in rat. The alcoholic extract of the aerial parts of *E. tirucalli* possessed CNS depressant activity in mice. It revealed anticonvulsant activity against metrazol seizures. It showed antagonism to phenylquinone writhing (Dhar *et al.*, 1968). The alcoholic extract of entire plant *E. dranunculoides* also showed CNS depressant activity in mice. It had anticonvulsant activity against supramaximal electro-shock seizures. It also gave positive results in amphetamine hyperactivity test (Bhakuni *et al.*, 1969).

The latex of *E. neriifolia* was found to be a powerful contact poison but weaker as a stomach poison. Its insecticidal effects were studied on *Oxya velox* E. and *Attracto-moraha camulata* F. Toxicological studies of the latex were done in mice. It produced pathological changes in the liver, heart and kidney (Rizvi *et al.*, 1969).

The water soluble fraction of the alcoholic extract of powdered whole plant of *Dugdhika* (*E. thymifolia* and *E. prostrata*) has been found to have relaxant action on isolated ileum of rabbit, guineapig and tracheal chain of dog, similar to that shown by papaverine. The drug had significant antispasmodic and bronchodilator effect in guineapigs (Sharma and Sharma, 1972).

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The ether extracts of *E. prostrata* and *E. thymifolia* were found to have powerful antifungal activity *in vitro* against *Trichophyton mentagrophytes* (Rao and Gupta, 1970).

The petroleum-ether, ether and linseed oil extracts of *E. prostrata* and *E. thymifolia* showed a persistent *in vitro* anti-fungal activity against *T. mentagrophytes*, *T. simii* and *Microsparum gypeum* (Pal and Gupta, 1971).

The ether extract of *E. thymifolia* and *E. prostrata* were found to be very effective in controlling sarcoptic mange in sheep (Lal and Gupta, 1970).

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## EVODIA (Rutaceae)

*E. XANTHOXYLOIDES*

**Chemistry* :** Synthesis of the acridone alkaloid evoxanthine has been reported. The diphenylamine-2-carboxylic acid was prepared by Ullmann condensation of 3-methoxy-4, 5-methylenedioxyaniline with 2-bromobenzoic acid. Ring closure of II with phosphorus oxychloride can take place in two ways giving methoxy or 3-methyoxy-9-chloroacridine. A mixture of these 9-chloroacridines was obtained and chromatography over alumina afforded compound A, m.p. 172-174° and compund B, m.p. 218-220° in proportion 4 : 1. By analogy, compound A was proved to be 1-methoxy-9-chloroacridine—its physical constants were in agreement with those reported for evoxanthidine and further, the N-methyl derivative proved to be identical with natural evoxanthine (Govindachari *et al.*, 1967).

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## EVOLVULUS (Convolvulaceae)

*E. ALSINOIDES* Linn.

| | | | | | |
|---|---|---|---|---|---|
| Hind. | — | Sankhapushpi | Sans. | — | Vishnukraanti |
| Kan. | — | Vishnukranti | Tam. | — | Visnukarandi |
| Mal. | — | Vistnaclandi | Tel. | — | Vishnukraanti |
| Mar. | — | Shankha valli | | | |

*No report available on other aspects.

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**Habitat :** Common weed in open and grassy places almost throughout India, ascending to 2000 m. in the Himalayas.

**Parts used :** Whole plant and leaves.

**Ayurvedic description :** *Vishnukranti* is said to be a blue flower variety of *Shankhapushpi* which is often confused either with *Clitoria* or *Convolvulus pluricaulis*. *Convolvulus* is a white flowered variety and should be accepted as *Shankhapushpi*. White *Convolvulus* which is very closely allied to the *Convolvulus* with blue flowers may be the *Vishnukranti*. According to south Indian vaidyas, *Clitoria*, which gives both blue and white flowers should be accepted as *Shankhapushpi*.

**Medicinal properties and uses :** The plant is a bitter tonic, febrifuge, and vermifige and used in dysentery. Leaves are made into cigarettes and smoked in chronic bronchitis and asthma. It is also used as anthelmintic and anti-phlogistic (Chopra *et al.*, 1956; Nadkarni, 1954).

**Chemistry and Pharmacology :** Betaine and another water soluble base, m.p. 60-61° have been isolated from the whole plant *E. alsinoides*. Petroleum ether, benzene and chloroform extracts gave colour reactions for sterols, chloroform, alcohol and water extracts gave positive tests for alkaloids. The water extract also contained proteins, aminoacids, carbohydrates, phenolic compounds and tannins. The exhausted marc on maceration with 5 per cent hydrochloric acid yielded more of alkaloids.

The alkaloidal mass was fractionated by column chromatography. Solvent ether alone eluted alkaloidal fraction A which was presumed to be evolvine, on the basis of physical characters. The eluates containing water soluble fractions C and D were evaporated. These could be resolved by trituration with dry acetone, when fraction D dissolved leaving fraction C and A as granular residue. Fraction C was identified as betaine.

Fraction D base obtained above was studied for its effect on pithed frog heart and on isolated rabbit intestinal loop. In low doses (0·02 mg.), it decreased heart rate and force of cardiac contraction. In larger doses (0·1 mg.), it caused cardiac arrest in diastole. It decreased the amplitude of contraction and increased the tone of intestinal muscle in concentration of 1 : 500,000 to 1 : 250,000 (Baveja and Singla, 1969).

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# FAGONIA (Zygophyllaceae)

*F. ARABICA* Linn. (Syn. *F. mysorensis* Roth *F. bruguieri*, DC, *F. cretica* Linn.)

Guj. and Mar. — Dhamasa

Hind. — Ustarkhar
Punj. — Samada

**Habitat :** Small spiny shrub with erect branches found throughout north western India, especially Punjab and also in Deccan.

**Parts used :** Leaves, twigs and juice.

**Ayurvedic description**

Sanskrit : *Dhanvayaasa*

Synonyms : *Duraalabha, duhsparsha, ushtrabhaksya, dhanvayavasa, marudbhava, moola, samudraanta, nishkantaka, yaasa, yaavasa, taamramoolee, baalapatra, kachchura, harivigraha, gaandhaari*

Properties :
*Rasa* — *Tikta, kashaaya, madhura, katu*
*Guna* — *Laghu, rooksha*
*Veerya* — *Sheeta*
*Vipaaka* — *Katu, madhura*

Actions/Uses : *Daahaprashamana, vishamajwaraghna, tritprashamana, chardiprashamana, pramehaghna, jwaraghna, gulmahara, kushtaghna, kaasaghna, bhramaghna, raktashuddhikara, visarpaghna, vamanaprashamana.*

**Medicinal properties and uses :** Leaves, twigs and juice are bitter tonic, diuretic and astringent. Leaves and twigs possess cooling and antiseptic properties (Nadkarni, 1954).

**Pharmacology* :** The aqueous solution and the sodium salt obtained by shaking the residue of the alcoholic extract of *F. arabica* with sodium hydroxide were found to have significant stimulant action on isolated uteri of rat and guineapig. The aqeuous extract had a stimulant action on the isolated intestine of rabbit, which was antagonised by atropine. Sodium salt produced hypertensive effect whereas aqueous solution caused hypotension in dogs. Both these caused tachyphylactic effect on blood pressure. The aqueous extract showed negative inotropic effect on the isolated frog and rabbit heart perfusion (Sharma and Singh, 1960).

*No report available on other aspects.

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The alcoholic extract of the aerial parts of *F. cretica* was found to have anti-viral activity against *Ranikhet disease virus*. It manifested CNS stimulant activity as evidenced by amphetamine hyperactivity test (Dhar *et al.*, 1968).

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## FERONIA (Rutaceae)

*F. ELEPHANTUM* Correa. (Syn. *Crataeva vallanga* Koen., *F. limonia* (Linn.) Swingle).

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Kathbel | Kon. | — | Belpatri-phal |
| Eng. | — | Elephant or wood apple | Mal. | — | Vilava |
| Guj. | — | Kotha | Mar. | — | Kavitpana |
| Hind. | — | Kavat, kavitha, kaitha | Tam. | — | Narivila, vilaambazham |
| Kan. | — | Belada-hannu | Tel. | — | Velaga |

**Habitat :** Occurs throughout India and also cultivated for its fruit.

**Parts used :** Fruit, gum, leaves and bark.

**Ayurvedic description**

Sanskrit : *Kapittha*

Synonyms : *Dadhistha, surabhichchada, pushpaphala, kapipriya, dantashatha, phalasugandhika, chirapaakee, gandhapatra, kantee, karabhithoo, graahiphala, dadhi, kashaayaamlaphala*

Properties :
*Rasa* — *Madhura, amla, kashaaya*
*Guna* — *Laghu, rooksha*
*Veerya* — *Sheeta*
*Vipaaka* — *Madhura, amla, katu*

Action/Uses :
Leaves — *Hikkaghna, chardihara, ateesaaraghna*
Flowers — *Aakhuvishaghna*

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Unripe fruit— *Kashaaya, laghu, rooksha, amla, graahi, lekhana*

Ripe fruit — *Guru, madhura, kashaaya, amla, shwaasaghna, kaasaghna, aruchihara, trishnaashamana, kanthashodhana, vrishya, sangraahee, vranashamana, hikkaashamana, ruchiprada, vishaghna, mootradoshahara*

Seeds — *Garavishaghna, kapaalavisarpaghna*

**Medicinal properties and uses :** Fruit is aromatic, antiscorbutic, astringent and refrigerant. Gum from the stem is demulcent. Leaves are aromatic, carminative and astringent (Nadkarni, 1954). Bark is prescribed for biliousness (Chopra *et al.*, 1956).

**Chemistry :** Earlier studies on *F. elephantum* have led to the isolation of a number of basic, neutral, and polyphenolic components. A reinvestigation has now been made of the leaves. Earlier workers reported the presence of bergapten and stigmasterol in them. The leaves were extracted with ethanol and the solvent concentrated under reduced pressure. The concentrate was treated with more water and extracted with : petroleum ether, ether and ethyl acetate. Besides these extracts, the aqueous solution was also examined. The petroleum ether soluble fraction yielded stigmasterol and ether soluble fraction yielded two compounds *viz.* psoralen and bergapten. The ethyl acetate soluble fraction on paper chromatography yielded three flavone glycosides. From their chemical properties and spectral data they were identified as the flavonoid C-glucosides, orientin, vitexin and sponarin respectively.

The aqueous portion was subjected to continuous liquid extraction using ethyl acetate when it yielded a yellow solid containing the above glycosides. The identification of photodynamic compounds psoralen and bergapten and of the flavonoid C-glycosides, may help in a better understanding the therapeutic properties of the leaves (Sharma, 1974).

**Pharmacology :** A keto-lactone isolated from the trunk bark of *F. elephantum* exhibited a depressor action on the frog heart and the blood pressure of intact and spinal dogs. It had a powerful spasmogenic action on isolated rabbit gut. These actions could be completely abolished by atropinization. The action of the compound seemed to be mediated through cholinergic mechanism (Mishra *et al.*, 1963).

The essential oil obtained from *F. narthex* produced a marked depression of the frog's heart together with a pronounced and long-lasting vasodilation in the rat hind quarter perfusion experiment. Studies on isolated guineapig and rabbit ileum revealed that the spasmolytic action of the oil affected the smooth muscles of the blood vessels and intestine. In anaesthetized dogs, the oil produced a marked depressant effect and

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caused arrest of mobility followed by a negative response to pain. It produced a marked stimulatory action on the respiratory system. The drug was found to be non-toxic and its effects were reversible and transient. It caused sudden fall in blood pressure indicating that it did not act by depletion of noradrenaline from peripheral sites as did reserpine. Atropinization did not block the hypotensive effect (Kar and Menon, 1971).

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## FERULA (Umbelliferae)

*F. FOETIDA* Regel.

| | | | | | |
|---|---|---|---|---|---|
| Ben. and Hind. | — | Hingra | Punj., Guj., Mar. and Kon. | — | Hing |
| Kash. | — | Yang | Tam. | — | Perungayam |
| Kan. and Mal. | — | Hingu | Tel. | — | Inguva |

**Habitat :** The plant grows wild in Kashmir, Persia and Afghanistan.

**Parts used :** Oleo-gum-resin (asafoetida).

**Ayurvedic description**

Sanskrit : *Hingu*

Synonyms : *Raamatha, baahleeka, vahnika, atyugra, bhootanaashanee, agoodhagandha, jarana, jantughna, soopadhoopana, sahasravedhi, jatuka*

Properties : *Rasa* — *Tikta, katu*
*Guna* — *Laghu, teekshna*
*Veerya* — *Ushna*
*Vipaaka* — *Katu*

Actions/Uses : *Paachanee, deepanee, ruchya, krimighna, streepushpajanaee, balya, hridya, vishaghna, vibandhaghna, aanaahaghna, shoolaghna,*

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*gulmaghna, vaatabalaasahara, udararogaghna, moorchaahara, apasmaarahara, agnimaandyaghna, hridrogashamana, kaasaghna, shwaasghna*

Gum : *Chedanee, anulomanee, deepanee.*

**Medicinal properties and uses :** Asafoetida is a stimulant, carminative, antispasmodic, expectorant and mild laxative. It is also anthelmintic, diuretic, aphrodisiac and emmenagogue. It is a nervine and pulmonary stimulant. It acts on the organs of circulation and secretion which it stimulates. If taken for a long time even in moderate doses, it gives rise to alliaceous eructations, acrid irritation in the throat, flatulence, diarrhoea and burning in the urine. The volatile oil is rapidly excreted and may be found in the urine, milk and sweat (Nadkarni, 1954; Chopra *et al.*, 1956).

*F. NARTHEX* Boiss.

| | | | |
|---|---|---|---|
| Hind., Ben. and Mar. | — Hing | Sans. | — Hinguka |
| Kash. | — Anjudan | Tam. | — Perungayam |

**Habitat :** It grows in north west Himalayas and its oleo-gum-resin is used as a substitute for asafoetida.

**Parts used :** Oleo-gum-resin, roots, stem and leaves.

**Medicinal properties and uses :** The oleo-gum-resin is used for the same purpose as asafoetida. The roots are reported to have antipyretic effect while its stem is considered to be a good tonic for brain and liver. The leaves possess diaphoretic and carminative properties (Chopra *et al.*, 1956).

**Pharmacognosy :** Pharmacognostic investigations on the root, stem and leaf of *F. jaeschkeana* and *F. narthex* have been carried out..

*F. jaeschkeana* is a tall perennial herb producing a bunch of radical leaves. Its roots are thick and on slight wounding, yield a white, sticky substance having a strong smell. The skeletons of dead leaf bases are present in the form of brown coloured fibres at the top of the roots. The stem is erect and thick bearing large sheaths of cauline leaves. The leaves are compound, 2-4 pinnate and pubescent.

Anatomically, the root shows a normal diarch structure in the beginning. Secondary growth takes place at an early stage. A large number of secretory canals (oleo-gum-resin canals) are scattered in the secondary phloem region disposed more or less in concentric rings with crushed phloem patches in between. The parenchymatous cells of the secondary phloem are densely filled with starch grains. As the thickness

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of the root increases, the secondary growth assumes a different form due to the meristematic activity of strips of xylem parenchyma cells which become connected to the primary cambial arcs through the xylem ray cells forming small secondary cambial rings. By the continued activity of these cambial rings, and the phloem tissues produced peripherally by them, the intervening ground tissue of the root becomes disintegrated so that vascular rings become progressively more and more marked. Thus, a variable number of vascular strands arise inside the periderm each of which has its own cambial ring encircling it.

In a transection, the stem shows an almost circular outline. Collenchymatous patches are present at regular intervals and in between these, some layers of chlorenchyma cells are observed. Secondary canals are present beneath each collenchymatous patch of cells. Vascular bundles are arranged in a ring connected by fibrous patches. Numerous collateral medullary bundles are observed in the pith region.

The petiole shows an oval outline with an adaxial shallow groove. Patches of collenchyma cells are present at regular intervals beneath which is invariably seen a secretory canal. Chlorenchyma cells are observed in between the collenchyma patches. Collateral vascular bundles are arranged in a ring with a few more in the centre. The lamina is isobilateral. The midrib is projected below and shows prominent ridges and grooves. Below each ridge is present a collenchymatous patch and in between them small patches of chlorenchyma cells are seen. Numerous collateral vascular bundles are observed. Stomata occur on both surfaces of the lamina and are of anomocytic type. A few trichomes are seen on the under surface.

The plant *F. narthex* is very similar to *F. jaeschkeana*. Anatomically also it resembles *F. jaeschkeana* to a certain extent. As the roots grow in thickenss, there is a tendency towards splitting of the vascular tissue into numerous smaller bundles but there is no meristematisation of the interfascicular parenchyma to form secondary cambial strips as in the previous species, and thus no formation of circular cords occur.

The stem of *F. narthex* differs from the previous species in that there is no distinction between pith and cortex. Vascular bundles are numerous and scattered in the ground tissue much like in monocots. The petiole and the lamina are, on the whole, as in *F. jaeschkeana*.

The leaf constants like palisade ratio, stomatal index, stomatal number, veinislet number and veinlet termination number, together with ash values and fluorescence characteristics have been determined of all the plant parts of the two species (Mehra and Raina, 1972; Raina, 1974).

**Chemistry :** The isolation of various sesquiterpene constituents from the roots of *F. jaeschkeana* has been described. The major component of the root was found to be jaeschkeanadiol. Its sterochemistry was established by a direct correlation with laserol, a sesquiterpene from *Laserpitium latifolium*. Tentative structure have also been assigned

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to some of the minor constituents of *F. jaeschkeana*, based on spectral data coupled with some chemical evidence in some cases (Sriraman, 1973).

The quality of asafoetida obtained from *F. narthex* and *F. jaeschkeana* occurring common in Ladakh region up to 4,000 m. has been found to be good (Abrol and Chopra, 1962).

The dried roots and the mature dry fruits of *F. jaeschkeana* yielded on distillation 1·2 per cent and 2·8 per cent essential oil respectively. The oil contained about 25 per cent camphene and about 60-90 per cent α-pinene. The fruit oil contained an optically active d-α-pinene while the root oil contained inactive α-pinene (Handa *et al.*, 1957).

The roots of *F. jaeschkeana* yielded, on steam distillation, greenish blue oil with pleasant odour. Free acids, carbonyl, sulphur and phenolic acids were found absent in the oil. The characteristics of the oil have been recorded. On fractionation, the oil yielded 1-α-pinene, 1-cadinene, S-guaizulene, chamazulene and some hydrocarbons (Chaudhury and Handa, 1959). By column chromatography, the constituents of the oil could be easily fractionated into dl-pinene, 1-cadinene, azulenes, 1-α-pinene, cuminaldehyde, 2-cadinene and S-guaizulene (Vashist *et al.*, 1962).

On steam distillation, the fruits of *F. alliacea* yielded an oil (0·90 per cent) and some coumarins. The oil had a yellow colour and bitter taste, with pleasant smell. Various characteristics of the oil have been recorded (Bose and Dutt, 1940). The coumarins could be separated and identified by means of paper chromatographic technique. Ferulin was also identified. The most suitable solvent for the separation of coumarins has been found to be water (Chakraborty and Bose, 1956).

From the fruits of *F. alliacea*, a mixture of furocoumarins, byakangelicin, isopimpinellin and ferulin were isolated. Ferulin, $C_{17}H_{16}O_6$ was found to be a mixture of phellopterin $C_{17}H_{16}O_5$ and byakangelicol $C_{17}H_{16}O_6$ (Chatterjee *et al.*, 1962).

**Pharmacology :** Asafoetida has not been found to have any bacteriostatic effect or to bring about any morphological and cultural changes in the organisms causing common intestinal disturbances. On the basis of *in vitro* studies, its role in the alimentary tract has been inferred to be that of altering the proportion of hydrogen to carbon dioxide formed by the gas-producing micro-organisms in the intestines rather than that of aiding the digestive processes (Bhat *et al.*, 1954).

Asafoetida produced slight inhibition of growth of *Staphylococcus aureus* and *Shigella sonnei*. It had no antibacterial activity against *Escherichia coli*, *Aerobacter aerogenes*, *Leishmania casei* and *S. faccalis* (Subrahmanyan *et al.*, 1957).

The effect of byakangelicin, a coumarin isolated from the fruits of *F. alliacea*, on human chorionic gonadotrophin (HCG) has been studied. Complete inhibition of HCG hormone was observed with byakangelicin in a dose of 4 mg./toad (*Bufo melanostictus*). Anti-gonadotrophic assay of byakangelicin against HCG has also been done. It completely annulled the biological potency of HCG at 400 mcg./20 i.u. HCG

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*Ferula narthex*

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*Gloriosa superba*

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level. Evidence has been obtained for the presence of sulphhydryl (SH) groups in HCG. Addition of SH groups of the hormone to the 3 : 4 double bond of the coumarin has been suggested to be the most plausible mechanism of the inhibitory action of byakangelicin (Pakrashi, 1963*a*, 1963*b*).

The effect of byakangelicin has also been studied on female sex hormones and fertility of rats. The changes in gross uterine weight, histological and histochemical examination of tissues and vaginal smear indicated that byakangelicin partially blocked the uterotropic responses of exogenous estrogen. Byakangelicin had no effect on progesterone response of uterus. Its effect on the fertility of female rats was characterized by irregularity of estrus cycle, delay in mating and significant decrease both in fertile mating and in the number of off-springs. It also had some influence on the sexual maturity of immature female rats (Pakrashi, 1967*a*). The effect of the drug on placental gonadotrophins has been studied in immature female rats. From histological and histochemical evidences, it was suggested that byakangelicin inhibited the action of the hormone by affecting the sulphhydryl group contained in the ICSH factor of both human chorionic gonadotrophin and pregnant mare's serum gonadotrophin (Pakrashi, 1967*b*).

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## FICUS (Urticaceae)

*F. BENGALENSIS* Linn. (Syn. *Ficus indica* Linn.)

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Bar | Kan. | — | Aaladamara |
| Eng. | — | Banyan tree | Kon. | — | Goeliruku |
| Guj. | — | Vad | Mal. | — | Paeral |
| Hind. | | | Mar. | — | Vada |
| and Punj. | — | Bor | Tam. | — | Aalamaram, pudavam |
| | | | Tel. | — | Marichettu. peddamatti |

**Habitat :** Grows wild in the lower Himalayas and is also found all over India.

**Parts used :** Milky juice and bark.

**Ayurvedic description**

Sanskrit : *Vata, nyagrodha, dhruva, ksheeree, bahupaada, shringee*

Properties : *Rasa* — *Kashaaya*
*Guna* — *Guru, rooksha*
*Veerya* — *Sheeta*
*Vipaaka* — *Katu*

Actions/Uses : *Graahi, varnya, yonidoshaghna, vranaghna, visarpahara.*

**Medicinal properties and uses :** Bark is a tonic, astringent, cooling and diuretic, seeds and fruits are cooling and tonic. Young buds and milky juice are astringent (Nadkarni, 1954).

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*F. GLOMERATA* Roxb.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Jagnadumar | Mar. | — | Umbar |
| Eng. | — | Cluster-fig | Punj. | — | Kath-gular |
| Guj. | — | Umbaro | Tam. and Mal. | — | Attimaram |
| Hind. | — | Gular | Tel. | — | Attimanu |
| Kan. | — | Attimara | | | |
| Kon. | — | Rumdi-rooku | | | |

**Habitat :** Found all over India.

**Parts used :** Root, root-bark, leaves, fruits and milky juice.

**Ayurvedic description**

Sanskrit : *Udumbara*

Synonyms : *Hemadugdhika, haritaakshi, bahudruma, suchakshu, ksheera-druhe, sheetavalkala, kaanchanee, jantuphala, sadaaphala, apushpa, yajnaanga, suprateeha*

Properties :
*Rasa* — *Kashaaya, madhura*
*Guna* — *Guru, rooksha*
*Veerya* — *Sheeta*
*Vipaaka* — *Katu*

Actions/Uses : General : *Bhagnasandhaanakara, varnya, vranashodhana, vranaropana, stambhanee, trishnaahara, valaasahara*

Fruits : *Guru, madhura, kashaaya, sheetala, ruchya, tritshamana, mohaghna, chardihara, pradaraghna, asrasrutinaashana, kshutshamanee, mehaghna.*

**Medicinal properties and uses :** Bark, leaves and unripe fruits are astringent, carminative, stomachic, and vermicide (Nadkarni, 1954).

*F. RELIGIOSA* Linn.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Asud | Mal. | — | Areyal |
| Eng. | — | Peepul tree, sacred fig | Mar. and Kon. | — | Pimphala |
| Guj. | — | Jari | Punj. | — | Pipal |
| Hind. | — | Pipal | Tam. | — | Arasa-maram |
| Kan. | — | Rangi, basiri, aralimara | Tel. | — | Ravi |

**Habitat :** A large tree found wild as well as cultivated all over India.

**Parts used :** Root bark, fruit, seeds, leaves.

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**Ayurvedic description**

Sanskrit : *Ashwattha*

Synonyms : *Pippala, chalapatra, bodha, bodhee, gajaashana, satwarajanaashana, chaitya, chala, dala, shyaamala, swaadubeejaka, maangalya, ksheerapaadapa*

Properties : *Rasa* — *Kashaaya*
*Guna* — *Guru, rooksha*
*Veerya* — *Sheeta*
*Vipaaka* — *Katu*

Actions/Uses : General : *Vranaropana, yonivishodhana, raktapittashamana*
Fruits : *Shwaasahara, garbhasthaapana*

**Medicinal properties and uses :** Seeds and fruits are cooling, laxative, refrigerant and alterative while the leaves and young shoots are purgative; bark is cooling, astringent, sweet. Infusion of bark is astringent. Fruit is laxative and digestive (Chopra *et al.*, 1956; Nadkarni, 1954).

*F. RETUSA* Linn.

| | | | | | |
|---|---|---|---|---|---|
| Ben. and Hind. | — | Kamrup | Tam. | — | Kallichi |
| Mar. | — | Pilala | Tel. | — | Yerrajuvvi |

**Habitat :** Found in Chota Nagpur, Bihar, Madhya Pradesh, western Peninsula, south India to Ceylon, Sundarbans and Andamans.

**Parts used :** Juice of bark and leaves.

**Medicinal properties and uses :** Juice of bark is used in liver diseases. Powdered leaves and bark are useful in rheumatic headache. Root bark and laeves are boiled in oil and applied for wounds and bruises (Chopra *et al.*, 1956).

*F. TSIELA* Roxb.

| | | | | | |
|---|---|---|---|---|---|
| Hind. | — | Jari | Tam. | — | Ichi |
| Mal. | — | Koylai | Tel. | — | Peddajuvvi |
| Mar. | — | Pimpri | | | |

**Habitat :** Found in Madhya Pradesh and western Peninsula.

**Parts used :** Bark.

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**Medicinal properties and uses :** Bark is used in colic pains (Chopra *et al.*, 1956).

**Pharmacognosy :** A comparative study of macro and microscopic characters of the stem bark of *F. bengalensis* and *F. racemosa* showed that these can be easily identified when presented in a mixed condition in commercial or powdered samples. Their salient features are :

*F. bengalensis*—The outer surface of the bark shows a hard crusty layer, and is greenish black in colour. Outermost surface is characterised by transverse wrinkles with fine radial fissures, 2-8 mm. thick. Cortical region is brittle while pholem region is fibrous. Microscopically cork is made up of tangentially elongated thick walled cells. Phellogen is not conspicuous, phelloderm has tangential rows of cells filled with granular contents. Tangentially elongated stone-cells without pitting are present. Phloem fibres are thick walled, non-lignified with large lumen and are septate. Prismatic crystals of calcium oxalate measuring 5-20 μ × 8-23μ in diameter are present. Cluster crystals are absent. Starch grains are round and measure 5-16 μ in diameter and latex-tubes are present.

*F. racemosa* : The outer surface of the bark has easily removable translucent flakes of whitish tissue, greyish to rusty brown, 6-18 mm thick, uniformly hard and non-brittle. Microscopically the cork is made up of polygonal or rectangular cells. The phellogen is made up of 1-2 layers of thin-walled cells. Phelloderm is devoid of tangential rows of cells filled with granular contents. Some cortical cells contain resinous mass. Stone cells are rectangular or slightly isodiametric and pitted thick walled, non-lignified phloem fibres having narrow lumen without any septa, are present. Prismatic crystals of calcium oxalate measuring 11-25 μ × 14-42 μ in diameter and few clustered crystals are also present. Starch grains are ovoid to spherical and measure up to 8 μ in diameter. Laticiferous vessels with a light brown granular material are present in the phloem region (Chaudhury, 1966).

The bark of *F. glomerata* is grey and on drying, the pieces become curved. It has an indistinct odour and astringent taste. The cork has 3-8 layers of rectangular cells. Individual parenchymatous cells as well as sclereids are arranged in radial files with corresponding phellogen and cork cells. The cortex is wide with numerous sclereids. Phloem has sieve tubes, companion cells *etc.* Powder is light pink to light brown in colour (Nayar and Bisht, 1959).

The outer bark of *F. tsiela* is greenish-grey in colour and rough due to numerous lenticels, transverse and longitudinal cracks and wrinkles. The inner surface is smooth, longitudinally striated and reddish brown in colour. The young bark in transection shows an outer silicified epidermis, a few cells of which elongate to form hairs. Cork has 6-8 layers, followed by a wide zone of phloem, traversed by medullary rays. Phloem consists mostly of stratified layers of stone-cells and a few parenchyma cells. Laticiferous cells are present in the phloem and medullary rays. Starch grains, tannins, and crystals of calcium oxalate are also present in abundance (Mitra and Kapoor, 1972).

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**Chemistry :** The bark of *F. bengalensis* has been chemically analysed. A hypoglycaemic principle was isolated which appeared to be a glycoside. Its physical properties were : m.p. 160°, soluble in alcohol and water, insoluble in ether and acetone, the yield being 1 per cent.

A triterpene, friedelin and β-sitosterol were isolated from the leaves of *F. bengalensis* From the petroleum ether extract a compound was obtained with m.p. 255-56°, and analysed for $C_{30}H_{50}O$. The mass spectra of this compound was identical to friedelin. From the benzene eluant, a compound with m.p. 135-137° was identified as β-sitosterol (Chatterjee and Chakraborty, 1968).

The tigilic acid ester of γ-taraxasterol was isolated in 0·4 per cent yield from the heart wood of *F. bengalensis*. The flavonols of the leaves were identified as quercetin-3-galactoside and rutin (Subramanian and Nair, 1970).

β-sitosterol and lupeol have been isolated from the petroleum ether extract of the root-bark of *F. racemosa* (Sharma *et al.*, 1963).

β-sitosteryl-D-glucoside was isolated from the bark of *F. religiosa* as a white crystalline compound, m.p. 282-83°, molecular formula $C_{36}H_{60}O_6$ (Ambike and Rao, 1967).

**Pharmacological and clinical studies :** A glycoside isolated from the bark of *F. bengalensis*, produced a hypoglycaemic effect in normal rabbits but not in diabetic animals (Deshmukh *et al.*, 1960). The effect of varying the period of fasting so as to produce a satisfactory post-absorptive state was studied in normal and alloxan diabetic rabbits with the aqueous extracts of barks of *F. bengalensis* and *F. glomerata*. Both the extracts were found to reduce the blood sugar in normal as well as alloxan diabetic rabbits. An adequate period of fasting, creating a favourable post-absorptive state, was found to reveal the hypoglycaemic activities of these extracts in a better way (Shrotri and Aiman, 1960).

The aqueous extract exerted no significant effect on the fasting blood sugar of normal rabbits but a moderate lowering of fasting blood sugar was observed in alloxan diabetic rabbits (Vohora and Parasar, 1970*a*, *b*).

Clinical studies were conducted with the crude aqueous extract of the bark of *F. bengalensis* in 12 normal volunteers and 6 diabetic patients. These were given 100 ml. of 10 per cent aqueous extract orally and blood sugar levels were determined after 2 and 4 hours respectively. A control group of 6 persons received 100 ml. of distilled water. The results showed that the extract had no hypoglycaemic action on normal human beings although it showed mild hypoglycaemic activity in diabetic patients (Joglekar *et al.*, 1963).

Three flavonoid compounds A, B and C, were isolated from the ethanolic extract of the bark of *F. bengalensis*. All these compounds were individually effective as hypoglycaemic agents on oral administration to normal fasting rabbits, compound B

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having the maximum activity. This compound was also found to be fairly effective in controlling the hyperglycaemia produced by oral administration of glucose to normal fasting rabbits (Brahmachari and Augusti, 1964).

The milky sap of *F. bengalensis* caused initial lowering of fasting blood sugar in rats but subsequently the basal fasting level was found to be higher tha nthat in controls. A significant effect was observed on gluose tolerance after the third week of administration of the drug (Gupta, 1966).

β-sitosteryl-D-glucoside, isolated from the bark of *F. religiosa* showed hypoglycaemic activity which compared favourably with that of tolbutamide (Ambike and Rao, 1967).

The aqueous extract of the bark and leaves of *F. bengalensis* exhibited negative inotropic and hypotensive action in dogs. The cardiac actions were not found to be mediated through cholinergic receptors or vagus. The extracts induced marked relaxation in isolated rat ileum and virgin rat uterus preparation. The extracts also caused inhibition of acetylcholine-induced contractions of rat ileum, isolated rat uterus and isolated rectus abdominis muscle of frog. Contractions induced by the posterior pituitary in rat uterus were also inhibited by the extracts (Vohora and Parasar, 1969).

Acute and chronic toxicity tests were carried out with the aqueous extract of *F. bengalensis* in mice. Acute $LD_{50}$(i.p.) was found to be 9·47 g./kg. Chronic toxicity tests showed that the extract produced hepatic damage initially but the changes were found to be reversible on continued administration (Joglekar *et al.*, 1962).

The ethanolic extract of the leaves of *F. racemosa* on further extraction with benzene and ethyl acetate yielded an active fraction, rich in glycosides and this fraction was found to exert hypotensive and vasodilator effect on anaesthetized dogs and produced a depressant action in the rate and force of contraction of rabbit's isolated heart. In perfused frog heart, a decrease in the force of ventricular contraction was observed (Trivedi *et al.*, 1969).

The aqueous solution of the alcoholic extract of the bark of *F. religiosa* decreased the tone and diminished the amplitude of movements of isolated intestines of rabbit, guineapig, and albino rats and intestine *in situ* of dog. It also depressed the contractions of isolated uterus of rats. The extract showed antiacetylcholine but not antihistamine action on isolated guineapig heart. On the blood pressure of anaesthetized dog, it had vagolytic and antiacetylcholine actions but showed no antagonism to histamine. The extract relaxed the bronchial musculature of spinal dog and also antagonised acetylcholine spasm in tracheal chain of dog. All these actions were similar to those of atropine (Malhotra *et al.*, 1960*a*).

The hot alcoholic extract of the bark of *F. religiosa* relaxed the intestines of albino rat, guineapig, rabbit and dog and the uterus of rat. It antagonised different spasmogens. The extract blocked the cardiovascular effect of acetylcholine and was also vagolytic. It did not affect the cardiovascular effects of histamine. It protected

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guineapigs against acetylcholine and histamine-induced asthma. Oral $LD_{50}$ in albino rats was 2·24 g./kg. while intravenous $LD_{50}$ was 0·80 g./kg. (Malhotra *et al.*, 1960*b*).

β-sitosteryl D-glucoside produced CNS stimulation, convulsions and reversal of reserpine depression in mice at toxic dose levels. $LD_{50}$ was found to be 62 mg./kg. in mice by intraperitoneal route (Ambike and Rao, 1967).

The alcoholic extract of the stem bark of *F. racemosa* possessed antiprotozoal activity against *Entamoeba histolytica*. It also showed hypoglycaemic activity in albino rats. The stem bark of *F. religiosa* also possessed anti-protozoal activity against *E. histolytica* and showed anthelmintic activity against *Ascaridia galli* and anti-viral activity against *Ranikhet disease virus* (Dhar *et al.*, 1968).

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## FOENICULUM (Umbelliferae)

*F. VULGARE* Mill. (Syn. *Anethum foeniculum* Linn.)

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Panmouri | Kan. | — | Sompu |
| Eng. | — | Fennel | Tam. | — | Shombu, sohikeerai |
| Guj. | — | Warialli | Tel. | — | Sopu |
| Hind | — | Bari saunf | | | |

**Habitat :** A native of Europe, but commonly cultivated throughout India.

**Parts used :** Fruit, leaves, root and oil from fruits.

**Ayurvedic description**

Sanskrit : *Shatapushpa*

Synonym : *Shataahwa*

Properties : *Rasa* — *Madhura, katu, tikta*
*Guna* — *Laghu, snigdha, teekshna*
*Veerya* — *Ushna*
*Vipaaka* — *Madhura*

Actions/Uses : *Deepani, vrishya, stanyavardhini, ruchya, vranaghna, jwaraghna, netra-vranahara, akshirogaghna, gulmaghna, shleshmaateesaaraghna, vrana-ghna, daahashamani, shoolahara, aamadoshaghna, trishnaashamni, chardhighna*

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**Medicinal properties and uses :** Fruits are stimulant, aromatic, stomachic, carminative and emmenagogue; leaves are diuretic and root is purgative. Oil from fruits is used as a vermicide (Chopra *et al.*, 1956; Nadkarni, 1954).

**Pharmacognosy :** Morphological and anatomical characters of the fruits and studies on the essential oil of *F. vulgare* obtained from Ooty have been compared with the authentic sample. Anatomically some minor differences were noted, *e.g.* the vascular strands and vittae are much more developed than those of the common fennel. The walls of epicarp cells are beaded and much more thickened than those of the walls of common fennel. Ooty samples contained a high percentage of volatile oil, up to 8·5 per cent, which was devoid of anethol and contained estragole as the main constituent Chemical races have been found to occur in the fruits of *F. vulgare* as well (Shah *et al.*, 1969*a*, 1970).

**Chemistry :** The fruits of *F. vulgare* collected from Ooty were found to be free of anethole and represented a methyl chavicol race of *F. vulgare*. The volatile oil content of the fruit was up to 8 per cent. By TLC using silica gel-G as adsorbent and anethole and methyl chavicol as reference, the presence of methyl chavicol was detected and its identity confirmed (Shah *et al.*, 1969*b*).

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## FRITILLARIA (Liliaceae)

*F. IMPERIALIS* Linn.

**Habitat :** Found in Kashmir at 1660-3000 m., abundant near Baramulla.

**Parts used :** Bulbs and fresh plant.

**Medicinal properties and uses :** Bulbs are emolient, resolvent and diuretic. Fresh plant is toxic (Chopra *et al.*, 1956).

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**Chemistry :** Imperialine and three new alkaloids cevanin, $C_{27}H_{44}N_2O_2$, m.p. 272-3°, cevacin, $C_{27}H_{45}NO_2$, m.p. 178-83°, and a compound with m.p. 145-6°, were isolated from the bulb of *F. imperialis* (Suri and Ram, 1969).

**Pharmacology :** Imperatine, the major alkaloid isolated from the plant exerted relaxant and spasmolytic actions against various spasmogens on uterine, intestinal, bronchial, tracheal and vascular muscles. The spasmolytic activity was found to be similar to that of papaverine (Mir and Ghatak, 1965). The minor alkaloidal fraction of the plant showed an appreciable fall in the blood pressure of anaesthetised dogs due to cardiac depression and peripheral vasodilatation. On frog's heart, the alkaloidal fraction exhibited cardiotonic effect and also antifibrillatory activity resembling that of guanidine and spasmolytic activity similar to that of papaverine (Mir and Ghatak, 1966).

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# FUMARIA (Fumariaceae)

*F. INDICA* (Haussk) Pungsley (Syn. *F. parviflora* Lamk.)

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Shotara, pitpapra | Guj. | — | Pittapapdo |
| Eng. | — | Common fumitory | Kan. | — | Parpataka |
| Hind. | | | Kash. | — | Shahterah |
| and Mar. | — | Pitpapra | Tam. | — | Turu, thusha |
| | | | Tel. | — | Chata-rashi |

**Habitat :** The plant is not indigenous to India, but is imported into the country from Persia. It is found in many parts of India from Indo-Gangetic plain and Nepal down to the Nilgiri mountains.

**Parts used :** Whole plant.

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**Ayurvedic description**

Sanskrit : *Parpata*

Synonyms : *Varatikta, pittahara, renu, kavacha, charmaahvya, rajorenu, charmakantaka, sookshmapatra, yavakantaka*

Properties : *Rasa* — *Tikta*
*Guna* — *Laghu*
*Veerya* — *Sheeta*
*Vipaaka* — *Katu*

Actions/Uses : *Sangraahi, raktavikaarashamana, raktapittahara, madhura, bhramaghna, aruchihara, daahahara, pittajwaraghna, kaphajwaraghna, pipaasashamani, chardighna*

**Medicinal properties and uses :** The plant is diuretic, diaphoretic, aperient, laxative and anthelmintic. It is used in low fever, to purify blood and also in skin disorders (Chopra *et al.*, 1956; Nadkarni, 1954).

**Pharmacognosy :** The macro and microscopic studies of the root, stem, petiole, leaf and fruit of *F. indica* and its adulterants have been described and ash and extractive values determined. Since *Peristrophe bicalyculata* Nees is also called *pitpara* and some commercial samples contained *Coronopsis didyma*, a comparative study of *F. indica*, *C. didyma* and *P. bicalyculata* has been done (Mehra *et al.*, 1968).

**Chemistry :** Seven alkaloids have been isolated from the alcoholic extract of whole plant *F. indica*. These are (*i*) protopine, $C_{20}H_{19}O_5N$, m.p. 207-209°; (*ii*) tetrahydrocoptisine; (*iii*) a tautomeric form of fumariline, a homogeneous gum, $C_{20}H_{17}O_5N$; (*iv*) a racemic mixture of bicuculline and its optical antipode, $C_{20}H_{17}O_6N$, m.p. 234-235°; (*v*) bicuculline; (*vi*) fumarilicine, $C_{20}H_{19}O_5N$, and (*vii*) narceimine, $C_{22}H_{21}O_9N$, m.p. 264-265° (Pandey *et al.*, 1971).

**Pharmacology :** The water soluble portion of 90 per cent ethanolic extract of stem and leaves of *F. parviflora* produced a marked relaxant effect on isolated rabbit ileum, dog's intestine *in situ* and spontaneously contracting isolated uteri of rat and guineapig. It had a nonspecific spasmolytic action on isolated rat and guineapig ileum as well as uterus and dog's tracheal chain preparation. There was a moderate fall in blood pressure without any effect on heart rate and respiration of dog. The hypotensive effect was not modified by atropine or mepyramine. On isolated frog heart, there was positive inotropic effect, not modified by adrenergic blocking agents. On frog's isolated blood vessels, there was a moderate dilation. A prolonged choleretic effect was observed in dog on intravenous administration (Bhattacharya *et al.*, 1969).

The total tertiary alkaloidal fractions obtained from the plant were found to have relaxant and nonspecific anti-spasmodic activity on isolated intestines of rabbit, guineapig and albino rat, isolated uteri of albino rat and guineapig, dog's tracheal chain and

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dog's intestine *in situ*. On intravenous administration, the drug showed a moderate but prolonged hydrocholeretic effect (Bhattacharya *et al.*, 1970).

Protopine, the major alkaloid of the plant produced a moderate to marked relaxation of isolated ileum of guineapig, rabbit and albino rat in a dose of 0·5-5·0 mcg./ml. It also inhibited spontaneous activity of isolated uterus of albino rat at a concentration of 2-10 mcg./ml. Protopine was found to be approximately equipotent to papaverine and had a non-specific spasmolytic action against spasms induced by DMPP, acetylcholine bromide, histamine dihydrochloride, barium chloride, 5-HT, creatinine sulphate and oxytocin on isolated ileum of guineapig and albino rat and uterus of albino rat. Protopine (5 mg./kg. i.v.) also produced marked relaxation of intestine *in situ* of anaesthetized dog without producing any effect on blood pressure. It produced a 2·5 fold rise in biliary flow of the anaesthetized dog (Pandey *et al.*, 1971).

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## GARCINIA (Guttiferae)

*G. MANGOSTANA* Linn.

| | | | |
|---|---|---|---|
| Eng. | — Mangosteen | Kan. | — Pannerale |
| Guj. and Mar. | — Mangostin | Kon. | — Tavir |
| Hind. and Ben. | — Mangustan | Mal. | — Mongusta |
| | | Tam. | — Mangushtanpazam |

**Habitat :** A native of Singapore, cultivated as a garden escape in Burma, Malaya and Madras.

**Parts used :** Rind and pulp of the fruit, leaves and bark.

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**Medicinal properties and uses :** Rind of the fruit is a powerful astringent, so also are the bark and young leaves. Rind and pulp or entire dried fruit are employed as specific remedies in chronic diarrhoea and dysentery. Fruit is regarded as a remedy for leucorrhoea, gonorrhoea and gleet (Nadkarni, 1954).

*G. MORELLA* Desr.

| | | | | | |
|---|---|---|---|---|---|
| Eng. | — | Indian gamboge | Mar. | — | Kokum |
| Hind. | — | Gotaghanba, kokam | Tam. | — | Korakapuli |
| Kan. | — | Kangushta | Tel. | — | Rival-chinipal |

**Habitat :** Found in southern India, eastern Bengal, Khasia hills, evergreen forests of northern Kanara, western Ghats from south Kanara and Mysore to Travancore up to 1000 m.

**Parts used :** Gum resin.

**Ayurvedic description**

Sanskrit : *Kankushtha*

Synonyms : *Kaakakushta, kolakaakula, viranga, ranga, pulaka, shobhana, kinjuvaalaka, vaaraka, kaakaphalakam*

Properties : *Rasa* — *Tikta, katu*
*Guna* — *Laghu*
*Veerya* — *Ushna*
*Vipaaka* — *Katu*

Actions/Uses : *Rechana, ruchya, vranavishodhana, shophaghna, gulmaghna, udaraghna, aadhmaanahara, krimighna, gudaartihara, vranaghna, shoolahara.*

**Medicinal properties and uses :** Gum resin is purgative, anthelmintic, used in dropsical affections, amenorrhoea, obstinate constipation and as vermifuge (Chopra *et al.*, 1958; Nadkarni, 1954).

**Chemistry :** The ripe fruit hulls of *G. mangostana* on extraction with hexane yielded a yellow solid which on chromatography gave three new xanthones *viz.* gartanin, $C_{23}H_{24}O_6$, m.p. 167°; 8-desoxygartanin, $C_{23}H_{24}O_5$, m.p. 165·5° and mangostin.

Further extraction of the fruit hulls with acetone gave a yellow solid which on column chromatography yielded mangostin and normangostin, $C_{23}H_{24}O_6$, m.p. 198-200°. Partially ripe fruits by a similar procedure gave only mangostin and β-mangostin.

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Gartanin and 8-desoxygartanin were the first xanthones with two 3, 3′-dimethylallyl side chains in the same ring. The structure of 8-desoxygartanin was found to be exactly similar to that of the acridone alkaloid atalaphylline, suggesting a similar biogenesis (Govindachari *et al.*, 1971).

Morelloflavone, a 3-(8) flavonyl-flavanone isolated from the heartwood of *G. morella* was found to be a new type of biflavonoid. On extraction of the coarsely powdered heartwood with cold acetone, a crude pigment was obtained, which, on preparative thin layer chromatography using the same adsorbent and solvent gave morelloflavone as bright yellow cubes, from methanol, m.p. 298° (decomp.). It analysed for molecular formula $C_{30}H_{20}O_{11}$ (Karanjgaokar *et al.*, 1967).

From the roots of *G. talboti*, two biflavones *viz.* talbotaflavone $C_{30}H_{20}O_{10}$ and morelloflavone $C_{30}H_{20}O_{11}$ have been isolated. Their structures have been derived on the basis of degradative and spectroscopic evidence (Joshi *et al.*, 1970).

The various pigments isolated from *Garcinia* sps. have been described in details in a review article (Venkataraman, 1973).

**Pharmacology :** β-guttiferin and α-1-guttiferin were found to be responsible for the cathartic activity of the gum resin and seed coat extract of *G. morella.* β-guttiferin was found more potent than α-1-guttiferin and in inducing catharsis (Santhanan and Rao, 1968).

The alcoholic extract of the aerial parts of *G. talboti* was found to possess antiviral activity against *Ranikhet disease virus* (Bhakuni *et al.*, 1971).

Morellin, obtained from *G. morella* has been widely used for promoting wound healing. A 2 per cent solution of morellin in olive oil was tried experimentally and clinically and has been found to enhance healing in the later phase of wound healing. Morellin was used in clinical studies on wounds of different aetiology (both infected and non-infected) in the form of tincture morellin and morellin extract dissolved in olive oil. The clinical trial showed promising results (Deshpande *et al.*, 1970).

## References

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Deshpande, P.J., Pathak, S.N. and Gode, J.D. 1970. Wound healing under the influence of certain indigenous drugs. **Advances in Research in Indian Medicine, B.H.U.,** Varanasi, p. 280.

Govindachari, T.R., Kalyanaman, P.S., Muthukumaraswamy, N. and Pai, B.R. 1971. Isolation of three new xanthones from *Garcinia mangostana* Linn. **Indian J Chem 9,** 505.

Joshi, B.S., Kamat, V.N. and Vishwanathan, N. 1970. The isolation and structure of two biflavones from *Garcinia talboti.* **Phytochemistry 9,** 881.

Karanjgaokar, C.G., Radhakrishnan, P.V. and Venkataraman, K. 1967. Morelloflavone, a 3-(8) flavonyl-flavanone from the heartwood of *Garcinia morella.* **Tetrahedron Lett 33,** 3195.

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Santhanan, K. and Rao, P.L.N. 1968. Antibiotic principle of *G. morella* XII. Characterisation of $\beta$ and $\alpha$-1-, guttiferins as cathartic principles of gamboge and seed coat of *G. morella*. **Indian J Exptl Biol 6,** 158.

Venkataraman, K. 1973. Pigments of *Garcinia* sps. First Prof. Seshadri Seventieth Birthday commemoration lecture under Indian National Science Academy, New Delhi.

## GAULTHERIA (Ericaceae)

*G. FRAGRANTISSIMA* Wall.

Ben. and Hind. — Gandapuro

Eng. — Indian wintergreen

**Habitat :** Occurs freely in the Nilgiris, Travancore and from Nepal to Bhutan and Assam.

**Parts used :** Votatile oil from the leaves.

**Medicinal properties and uses :** Oil is aromatic, stimulant, carminative and antiseptic. Also given in rheumatism, sciatica and neuralgia (Nadkarni, 1954).

**Chemistry :** Fresh leaves of *G. fragrantissima* were repeatedly extracted with alcohol. The evaporated extract was defatted with petroleum ether. The unsaponifiable matter obtained from the petroleum ether-solubles, yielded β-sitosterol. The petroleum ether insoluble residue of the original extract was treated with hot water. The aqueous extract was shaken with ethyl acetate and the ethyl acetate extract gave hyperoside. The water-insoluble portion was taken up in a water-immiscible organic solvent mixture and the solution was shaken with alkali when a precipitate separated at the interphase. Decomposition of the interphase precipitate yielded ursolic acid (Murthy and Babu, 1970).

**Pharmacology :** The alcoholic extract of the aerial parts of *G. fragrantissima* produced hypothermia in mice (Bhakuni *et al.*, 1971).

### References

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Murthy, K.S. and Babu, R.M. 1970. Chemical investigation of the leaves of *Gaultheria fragrantissima* Wall. **Indian J Pharm 32,** 176.

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## GELONIUM (Euphorbiaceae)

*G. MULTIFLORUM* A. Juss.

Hind. — Ban-naringa

Tel. — Sarugata

**Habitat :** Abundant in Bengal and the Circars, reaching northwards to the foot of Sikkim Himalayas.

**Parts used :** Bark.

**Medicinal properties and uses :** Bark is considered a good tonic for gums and prescribed for gingivitis. It is also used as a purgative (Chopra *et al.*, 1956).

**Chemistry* :** From the bark of *G. multiflorum* a new monohydroxy-triterpene has been isolated in addition to multiflaranol and banerenol. It has been identified as epimultiflorenol by conversion to epi-β-amyrin (Row and Rao, 1969).

### Reference

Row, L. Ramachandra and Rao, Sankara C. 1969. Crystalline constituents of Euphorbiaceae. The triterpene of *Gelonium multiflorum* bark. **Indian J Chem 7**, 207.

## GENTIANA (Gentianaceae)

*G. KURROO* Royle (Syn. *G. chiravita* Roxb.)

| | | | | | |
|---|---|---|---|---|---|
| Eng. | — | Himalayan or Indian gentian, chiretta | Kon. | — | Jirate-kaddi |
| | | | Mal. | — | Kiriyat |
| Guj. | — | Kadu chirayata | Mar. | — | Kirayet |
| Hind. | | | Punj. | — | Nilkant |
| and Ben. | — | Karu, kutki, chiretta | Tam. | — | Nilavembu |
| Kan. | — | Nelabevu | Tel. | — | Nelavemu |
| Kash. | — | Kiraita | | | |

**Habitat :** This species occurs in Simla, extending to Kashmir and north-western Himalayas at 1500-3300 m.

*No report available on other aspects.

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**Parts used :** Root-stalk (rhizome), roots and the entire dried plant.

**\ y ı r vedic description**

Sanskrit : *Bhoonimba*

Synonyms : *Kiraatatikta, ramasena, kiraataka, kattrinam, haimaastika, kairaataka, kaandatikta, ardhatiktaka, kaakapalaka.*

Properties : *Rasa* — *Tikta* (*katu* ?)
*Guna* — *Laghu*
*Veerya* — *Ushna*
*Vipaaka* — *Katu*

Actions/Uses : *Raktapittashamana, kushthaghna, mehahara, shwaasahara, kaasahara, daahaghna, jwaraghna, krimighna*

**Medicinal properties and uses :** The roots are used as bitter tonic, antiperiodic, antibilious, astringent, stomachic and anthelmintic. In large doses it is an aperient (Nadkarni, 1954).

*G. OLIVIERI* Grieseb (Syn. *G. dahurica* Fisch.)

**Habitat :** Grows in western Himalayas and Baluchistan.

**Parts used :** Entire plant

**Medicinal properties and uses :** Plant is used as a sudorific (Chopra *et al.*, 1956).

**Pharmacognosy:** The commercial drug of *G. kurroo* consists of cylindrical pieces of root and rhizome, roots being mostly smooth or may show a few wrinkles. The roots are sticky, bitter in taste, with an indistinct odour.

Microscopically there is a compressed cortex and a narrow phloem zone in the stem. Cortex contains oil globules and small calcium oxalate crystals. Intraxylary groups of phloem are observed in the aerial stem and rhizome. In the rhizome, the epidermis is composed of rectangular cells. Outer xylary phloem patches are present in the pith close to the primary xylem in the young rhizome. The root is tri or tetarch. Two or three layers of radially arranged rectangular meristematic cells mark the vascular cambium.

Both in the root and rhizome, the outer tissues are sloughed off by the activity of phellogen which arise successively inwards in the cortex and later in the pholem tissue. The anomolous splitting of the rhizome and root into separate strands occur in the older regions (Mehra and Jolly, 1968).

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(Note : Both *Gentiana kurroo* and *Swertia chirata* are in Ayurveda, described and used as *Bhoonimba* and *Kiraatatikta*; these two terms being synonymous. The properties, actions and uses ascribed to it are common to *Gentiana kurroo* and *Swertia chirata*).

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**Chemistry :** Oleanolic and ursolic acids have been isolated from the petroleum ether extract of the flowers of *G. olivieri.* Fractional crystallisation of the acetylated product from methanol afforded acetates of oleanolic acid, m.p. 267-8°, and ursolic acid m.p. 289-90° respectively. The identity of ursolic acid was confirmed by preparation of its methyl ester, m.p. 170·5-171·5° and methyl ester of acetyl ursolic acid, m.p. 246-7° (Sharma *et al.*, 1963).

### References

Mehra, P.N. and Jolly, S.S. 1968. Pharmacognosy of Indian bitters I. *Gentiana kurroo* Royle and *Picrorhiza kurroa* Royle ex Benth. **Res Bull Punjab Univ 19,** 141.

Sharma, R.C., Khan, S.V.M., Zaman, A. and Kidwai, A.R. 1963. Chemical examination of *Gentiana olivieri* Griseb. **Indian J Chem 1,** 409.

## GIRARDINIA (Urticaceae)

*G. HETEROPHYLLA* Decne.

| | | | | | |
|---|---|---|---|---|---|
| Hind. | — | Bichua | Punj. | — | Keri |
| Mal. | — | Anachchoriyanam | Tel. | — | Gaddanelli |

**Habitat :** Found in Mount Abu, Chota Nagpur and western Peninsula.

**Parts used :** Leaves.

**Medicinal properties and uses :** Leaves are used in headache and swollen joints; its decoction is given in fever (Chopra *et al.*, 1956).

**Chemistry and Pharmacology:** The acetone extract of the leaves was found to contain 5-hydroxy tryptamine (5-HT) and histamine. Chromatographic studies confirmed this. The presence of 5-HT was further indicated by a spasmogenic response on atropinised, oestrus rat uterus which was completely blocked by bromolysergic acid diethylamide. Presence of histamine was confirmed by the action of acid treated acetone extracts which contracted the atropinised guineapig ileum and elicited a fall in the blood pressure of cat. Both the responses were blocked by mepyramine (Saxena *et al.*, 1964). Acetylcholine was also found to be present in the extract. Its presence was shown by elicitation of spasmogenic responses in the mepyramine-treated ilea of guineapig and rabbit and by short-lived hypotensive effect in mepyramine pretreated cat. The potentiation of these responses by the anti-cholinesterase agent eserine and their specific

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blockade with atropine confirmed the acetylcholine-like nature of the active substance of the extract. Chromatographic studies also indicated its presence (Saxena *et al.*, 1966).

### References

Saxena, P.R., Kishor, K., Pant, M.C. and Bhargava, K.P. 1964. Pharmacologically active constituents of *Girardinia heterophylla* Decne. **J Pharm Pharmacol 16,** 361.

Saxena, P.R., Tangri, K.K. and Bhargava, K.P. 1966. Identification of acetylcholine, histamine and 5-hydroxy-tryptamine in *Girardinia heterophylia*. **Canadian J Physiol Pharmacol 44,** 621.

## GLOCHIDION (Euphorbiaceae)

*C. HOHENACKERI* Bedd.

Mal. — Kuluchan Mar. — Bhoma

**Habitat :** Found in western peninsula, Chota Nagpur and Orissa and is very common in Konkan.

**Parts used :** Bark.

**Medicinal properties and uses :** Bark is given in stomach disorders (Chopra *et al.*, 1956).

**Chemistry :** From the bark and root of *G. hohenackeri*, in addition to 3-epilupeol, two new triterpenes, glochidone and glochidiol, have been isolated and their structures determined. The hexane extract of the bark yielded a gum which on chromatographic studies gave a crystalline ketone, m.p. 164-165°, named glochidone, $C_{30}H_{46}O$. On further investigations two crystalline acetates were obtained. The monoacetate, m.p. 163°, molecular formula $C_{32}H_{52}O_2$, was found to be 3-epi-lupeol acetate.

The diacetate *viz.* glochidiol diacetate has the molecular formula $C_{34}H_{54}O_4$. On alkaline hydrolysis it gave an amorphous diol. Oxidation of glochidiol gave an α, β-unsaturated ketone, $C_{30}H_{46}O$, identical with glochidone.

The stereochemistry of the hydroxyl groups in glochidiol has been determined by the partial synthesis of three of the four possible stereoisomers of the dihydrodiol diacetate, all of which differ from dihydro-glochidiol diacetate (Ganguly *et al.*, 1966).

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**Pharmacology :** The alcoholic extract of the aerial parts of *G. hohenackeri* was found to have hypoglycaemic activity in albino rats. It also possessed antiviral activity against *Ranikhet disease virus* and showed CNS depressant activity in mice (Dhar *et al.*, 1968).

### References

Dhar, M.L., Dhar, M.M., Dhawan, B.N., Mehrotra, B.N. and Ray, C. 1968. Screening of Indian plants for biological activity. Part I. **Indian J Exptl Biol 6,** 232.

Ganguly, A.M., Govindachari, T.R., Mohamed, P.A., Rahimtulla, A.D. and Viswanathan, N. 1966. Chemical constituents of *Glochidion hohenackeri*. **Tetrahedron 22,** 1513.

## GLORIOSA (Liliaceae)

*G. SUPERBA* Linn.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Bishalanguli | Mal. | — | Manthori-kizhangu |
| Eng. | — | Superb lily | Mar. | — | Nagakaria |
| Guj. | — | Khadyanag | Punj. | — | Mulim |
| Hind. | — | Kalihari | Tam. | — | Kalappaikizangu |
| Kan. | — | Nangulika | Tel. | — | Adavinabhi |
| Kon. | — | Vaganakta | | | |

**Habitat :** An elegant, climbing plant common in Bengal and in low jungles throughout India, Burma, and Ceylon.

**Parts used :** Tuberous roots.

**Ayurvedic description**

Sanskrit : *Laangali*

Synonyms : *Shuklapushpi, kalihaaree, halini, vishalya, ananta, vahnivaktra, vahni-jihwaa, indupushpa, kaalihaari, seera, garbhapaatini, garbhanut, pradeepa, agnishikha, vahnimukha, pushpasaurabha*

Properties :

| | | |
|---|---|---|
| *Rasa* | — | *Katu, tikta, kashaaya* |
| *Guna* | — | *Teekshna, laghu, sara* |
| *Veerya* | — | *Ushna* |
| *Vipaaka* | — | *Katu* |

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Actions/Uses : *Garbhanaashana, vastishodhaka, balaasaghna, kushtaghna, shophahara, arshoghna, vranahara, jantughna.*

**Medicinal properties and uses :** Root is a tonic, antiperiodic, cholagogue, alterative and purgative. Contrary to popular belief, root is not poisonous in ordinary doses (Nadkarni, 1954).

**Pharmacology* :** The fresh juice of the plant was found to have a stimulant action on isolated uteri of guineapig, rabbit and human beings. It had a stimulant action on rabbit and dog uterus *in situ* and seemed to have direct action on uterine musculature. On isolated rat uterus, it showed a papaverine-like action (Tewari *et al.*, 1967).

The water soluble portion of alcoholic extract of the plant was found to possess strong oxytocic effect in isolated uterus of guineapigs, rabbits, dog and human beings, uterus *in situ* of guineapig, rabbit and dog, and isolated human round ligament. In isolated human fallopian tube, relaxation was followed by stimulation. In all these cases, action was found to be direct on the muscle and not mediated through the autonomic nervous system. In higher doses it initiated labour in pregnant rabbits (Tewari *et al.*, 1972).

While screening the petroleum ether, alcoholic and aqueous extracts of the plant for anti-fertility activity, the alcoholic and aqueous extracts were found to be toxic at a dose of 25 mg./kg. and 100 mg./kg. respectively (Saxena *et al.*, 1970).

### References

Saxena, S.K., Garg, S.K. and Chowdhury, R.R. 1970. Antifertility screening of plants, Part V. Effect of six indigenous plants on early pregnancy in albino rats. **Indian J Med Res 58,** 254.

Tewari, P.V., Prasad, D.N., Chaturvedi, C. and Das, P.K. 1967. Preliminary studies on uterine activity of *Gloriosa superba* Linn. and its adulterant *Costus speciosus* Sm. **J Res Indian Med 1,** 196.

Tewari, P.V., Sharma, P.V. and Prasad, DN. 1972. Experimental studies on the ecbolic properties of *Gloriosa superba* Linn. (Kalihari). **J Res Indian Med 7,** 27.

## GLYCINE (Papilionaceae)

*G. SOJA* Sieb and Zucc. (Syn. *G. max* Mer.)

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Gari-kulay | Hind. | — | Bhat, bhatwan |
| Eng. | — | Soyabean | Punj. | — | Bhut |

*See *Costus speciosus* for Pharmacognosy.

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**Habitat :** Found in the tropical Himalayas from Kumaon to Sikkim and Khasia and Naga hills.

**Parts used :** Entire plant, seeds, root and bark.

**Medicinal properties and uses :** Decoction of the bark is astringent (Nadkarni, 1954; Chopra *et al.*, 1956).

**Chemistry :** Earlier reports of the presence of a large number of isoflavones in soyabean were critically examined by Ahluwalia *et al.* (1953) who showed that there were only two isoflavones *i.e.* genistein and daidzein. Recent study of varieties grown in India indicated that these compounds are present only in small quantities (4 parts per 100,000) and though they have oestrogenic properties, they are not likely to cause any harm when the beans are consumed as food, because of the small quantities present (Ranganathan and Seshadri—unpublished data).

**Pharmacology :** The seeds of *Glycine soja* have been found to have marked hypoglycaemic and hypocholesterolemic effect in the normal rats (Pant *et al.*, 1968).

### References

Ahluwalia, V.K. Bhasin, M.M. and Seshadri, T.R. 1953. Isoflavones of soyabeans. **Curr Sci 22,** 363.

Pant, M.C., Uddin, I., Bhardwaj, U.R. and Tewari, R.D. 1968. Blood sugar and total cholesterol lowering effect of *Glycine soja* (Sieb and Zucc.), *Mucuna pruriens* (DC) and *Dolichos biflorus* (Linn.) seed diets in normal fasting albino rats. **Indian J Med Res 56,** 1808.

## GLYCOSMIS (Rutaceae)

*G. ARBOREA* (Roxb.) DC.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Ashshoura | Tam. | — | Konji |
| Hind. | — | Ben-nimbu | Tel. | — | Gongi |
| Mar. | — | Kirmira | | | |

**Habitat :** Found throughout India.

**Parts used :** Root and wood.

**Medicinal properties and uses :** Root after being pounded and mixed with sugar is given in low fever. Wood is used in snake-bite (Chopra *et al.*, 1956, 1969).

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**Chemistry:** Arborine and arborinine have been isolated from the leaves of *G. arborea*. Arborine, the major alkaloid, m.p. 155-156° was optically inactive and had the molecular formula $C_{16}H_{14}ON_2$, with one-N-methyl group. On soda lime distillation, it gave toluene methylaniline and ammonia.

On the basis of a critical study of the UV and IR absorption spectra of arborine, it has been shown that arborine is 2-benzyl-1-methyl-quinazol-4-one and not the tautomeric form 2-benzylidene-1-methyl-quinazol-4-one. This was further confirmed by NMR spectrum of arborine (Chakravarti *et al.*, 1961; Chakravarti, 1963).

An alkaloid arborinine, m.p. 175-76° isolated from the leaves of *G. arborea* has been found to be optically inactive and has the molecular formula $C_{16}H_{15}O_4N$. It had two methoxy groups in addition to one-N-methyl groups and one active hydrogen, present in a hydroxy group. Its structure was established as 2, 3-dimethoxy-1-hydroxy-10- methylacridone (Benerjee *et al.*, 1961).

A minor alkaloid, α-fagarine, m.p. 141-142°, and 3 other quinazolone derivatives have been isolated from *G. arborea*. They are glycosminine, m.p. 270-271°, 1-methyl-2-4-quinazolinedione and glycorine (hygroscopic), m.p. 145-147°, 1-methyl-2- quinazolone. Glycorine, reported as a new 4-quinolone base was found to be skimmianine. The biogenesis of quinazoline has also been discussed (Pakrashi and Bhattacharyya, 1963).

From the neutral fraction of the light petroleum extract of *G. arborea*, two isomeric triterpene alcohols of a new type *viz.* arborinol, m.p. 274°, and isoarborinol, m.p. 298-99°, alongwith myricyl alcohol, m.p. 89-90°, stigmasterol and β-sitosterol were isolated. The revised formulae for both arborinol and isoarborinol have been found to be $C_{30}H_{50}O$ (Pakrashi *et al.*, 1964).

Methylation and demethylation of the quinazoline alkaloids from *G. arborea* has also been studied (Pakrashi and Bhattacharya, 1968).

Glycozoline, m.p. 18-182°, an optically inactive neutral compound having the molecular formula $C_{14}H_{13}NO$ was isolated from *G. pentaphylla*. The homogeneity of the compound has been established by paper and thin layer chromatography. It gave a picrate $C_{20}H_{16}N_4O_8$, m.p. 182°. It has one methoxyl and one C-methyl group. The data led to the formulation of glycozoline as 3-methyl-6-methoxy carbazole. The structure has been confirmed by its synthesis (Chakraborty *et al.*, 1966).

The structure of glycozoline, a carbazole derivative from the root bark of *G. pentaphylla*, has been shown to be 3-methyl-6-methoxycarbazole (Chakraborty, 1969).

The isolation of skimmianine and three new acridone alkaloids from the root bark of *G. pentaphylla* has been reported. Based on the spectral evidence and chemical correlations, they were shown to be hitherto naturally unknown compounds. These are : noracronycine, m.p. 200°, $C_{19}H_{17}O_3N$; des-N-methyl-acronycine, m.p. 268-

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270°, $C_{19}H_{17}O_3N$ and des-N-methylnoracronycine, m.p. 246°, $C_{18}H_{15}O_3N$. Evidence was also presented to show that the two possible structures, 1-methoxy-2′, 2′, 10-trimethylpyrano-acridone for acronycine, were more correct (Govindachari *et al.*, 1966).

**Pharmacology :** The alcoholic extract of the aerial parts of *G. mauritiana* was found to have CNS depressant activity in mice. The extract produced hypothermia in mice and also reduced amphetamine hyperactivity (Bhakuni *et al.*, 1971).

Arborine caused inhibition of the action of acetylcholine on rat uterus, guineapig ileum as well as on skeletal muscle (Chakravarti, 1963).

Glycosine, an alkaloid isolated from *G. pentaphylla*, blocked the central action of mescaline and counteracted chemoconvulsions induced by strychnine or metrazol in mice. It also potentiated the thiopental-induced narcosis and prevented the precipitation of circling movement and convulsions caused by cocaine. The alkaloid also inhibited the contraction of toad's heart and produced hypotension in cats. Its potential utility as a therapeutic agent in some psychomotor disorders has been indicated (Dey and Chatterjee, 1968).

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# GLYCYRRHIZA (Papilionaceae)

*G. GLABRA* Linn.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Yashto-madhu | | | |
| Eng. | — | Sweetwood | Kan. | — | Jyesthamadhu, atimadhura |
| Guj. and Mar. | — | Jashtimadh | Tam. | — | Atimadhuram |
| Hind. | — | Mithilakdi, mulathee | Tel. | — | Yashti-madhukam |

**Habitat :** Grows in Arabia, Persian Gulf, Afghanistan, Turkestan, Asia minor, and Siberia. The plant is cultivated for its root in Punjab, sub-Himalayan tracts from Chenab eastwards, Sind and Peshwar valley, Burma and Andaman islands.

**Parts used :** Peeled root.

**Ayurvedic description**

Sanskrit : *Madhuyashti*

Synonyms : *Madhooka, madhuyashtika, madhuparna, madhurakaashta, madhusraava, valeetaka, kleetana, suprasiddha, madhuramoolika*

Properties :

| | | |
|---|---|---|
| *Rasa* | — | *Madhura, ishad tikta* |
| *Guna* | — | *Guru, snigdha* |
| *Veerya* | — | *Sheeta* |
| *Vipaaka* | — | *Madhura* |

Actions/Uses : *Ruchya, chakshushya, balya, varnakara, shukrala, keshya, swarya, shoshahara, kshayahara, vishanaashini, chardiprashamani, trishnaapaha, vranaghna, gulmahara, daahaghna, aruchihara, kaasaghna, raktapitta-shamana*

**Medicinal properties and uses :** Root is used as tonic, cooling, demulcent, expectorant, diuretic, emmenagogue and mild laxative. It is also used in scorpion-sting. Root is used as infusion, decoction, extract or lozenges and is useful as a demulcent in inflammatory affections or irritable conditions of the bronchial tubes, bowels and catarrh (Nadkarni, 1954).

**Chemistry :** One of the important constituents of the extract of the root is a sweet, white, crystalline glycoside named glycyrrhizin (madhuyashtin). Glycyrrhizin gave glycyrrhetinic acid on enzymatic hydrolysis. In addition to these two substances, the root also contained sucrose, starch, and acid resin, a bitter principle aspargin, malic acid and some proteinous fatty and inorganic matters (Haravey, 1959).

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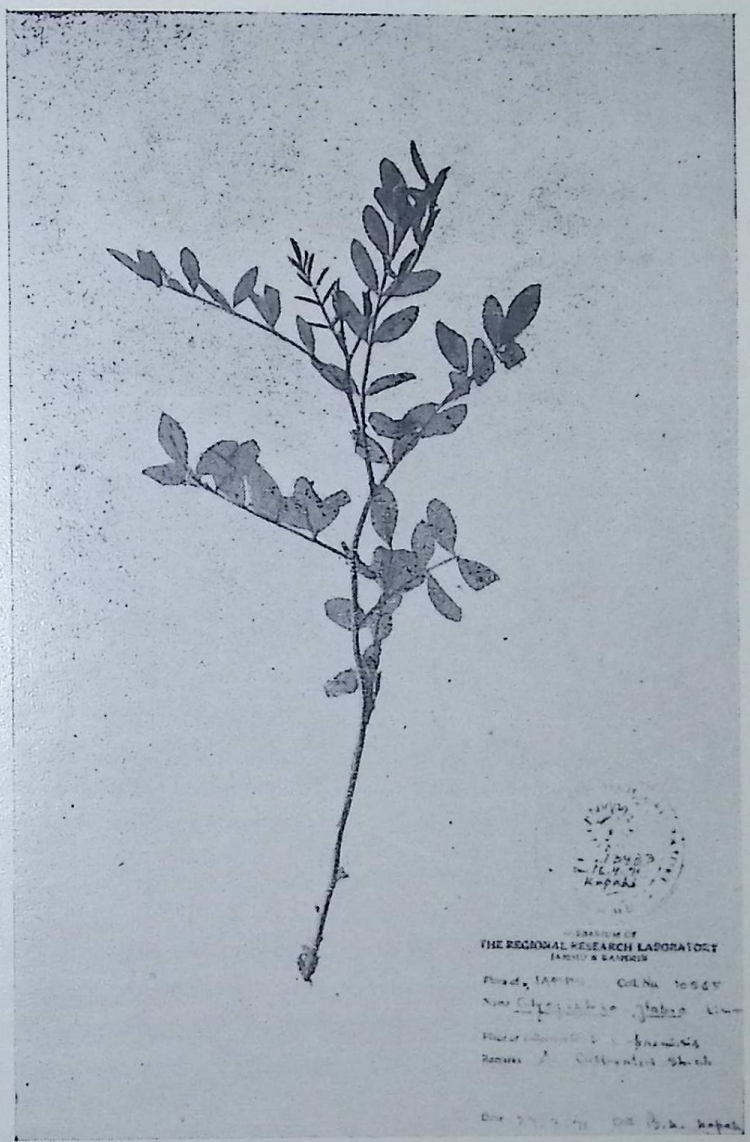


*Glycyrrhiza glabra*

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An improved method has been devised for obtaining glycyrrhetic acid from the drug and large quantities of it have been obtained (Rangawsami, 1970—Personnel communication).

*G. glabra* roots have been reported to contain many phenolic compounds also such as flavonoids and their glycosides, coumarin and cinnamic acid derivatives. Isolation of the glucosides, liquiritin (flavanone) and isoliquiritin (chalkone) along with their aglucones liquiritigenin (flavanone) and iso-liquiritigenin (chalkone) was made from Indian samples (Puri and Seshadari, 1954). More recently Indian samples have been found to contain unusual derivatives of 2-methyl isoflavones (Bhardwaj *et al.*, 1975).

**Pharmacological and clinical studies :** Glycyrrhizin, a glycoside obtained from *G. glabra* was studied for its anti-arthritic and anti-inflammatory effect on formaldehyde induced rat-paw oedema in adrenalectomised rats. It was found to potentiate the anti-arthritic action of hydrocortisone in rats (Gujral *et al.*, 1961*a*). Further studies showed that the anti-inflammatory activity of glycyrretic acid and its diacetate was similar to that of hydrocortisone on formalin-induced arthritis in albino rats. Methyl glycyrrhetic acid and glycyrrhetic acid diacetate were found to be more potent than glycyrrhetic acid. Glycyrrhetic acid, methyl glycyrrhetic acid and hydrocortisone prevented the elevation of SGOT and SGPT during inflammation. However, in normal rats, these agents reduced the SGPT level but not the SGOT level. ATP-ase activity in brain and liver homogenates remained unaltered during inflammation but was significantly elevated by these agents (Tangri *et al.*, 1964, 1965).

The aglycone of the glycoside glycyrrhizin *viz.* glycyrrhetic acid as well as crude *Glycyrrhiza* extract did not prolong the survival time of adrenalectomised rats. The compound did not cause any depletion of ascorbic acid contents of the adrenal gland (Gujral *et al.*, 1961*b*). Glycyrrhetic acid protected guineapig against bronchospasm induced by histamine or 5-HT, but unlike acetylsalicyclic acid, it did not have any action against bradykinin-induced writhing in mice. The interference with mucopolysaccharide synthesis by influencing aminotransferase and ATP-phosphohydrolase by glycyrrhetic acid and other agents may be responsible for anti-inflammatory activity against proliferative phase of inflammation. Glycyrrhetic acid significantly lowered plasma corticosterone concentration although adrenal weight remained unaltered. Thus, an endogenous release of corticoids by glycyrrhetic acid was not found to be responsible for its anti-inflammatory activity. The decrease in plasma corticosterone level by glycyrrhetic acid could be a result of increased enzyme activity catabolizing corticoids due to the durg. Oxyphenbutazone, on the other hand, did not show such and activity (Tangri *et al.*, 1968).

*G. glabra* and glycyrrhetic acid on oral administration were found to be less active than phenylbutazone in mycobacterial adjuvant-induced arthritic rats. These did not cause any improvement in the secondary lesions (Siddiqui, 1965).

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Glycyrrhetinic acid, the triterpenoid aglycone obtained by acid enzymatic hydrolysis of glycyrrhizin, resembled the steroids in certain aspects. Thus its functional efficacy and its specificity as a steroidal agent was studied in bilaterally adrenalectomised rats by observing its effect on the survival time as well as on granuloma formation by cotton pellet method in comparison to aldosterone and hydrocortisone respectively. Clinically, in cases of rheumatoid arthritis, the effect of glycyrrhetinic acid was studied on the excretion of 17-hydroxy corticosteroids in 24 hour urine, in comparison to triamcinolone. The drug did not seem to suppress endogenous cortisol (Malhotra and Ahuja, 1969).

The oral administration of powdered root of *G. glabra* in 5 cases of pemphigus, who had been kept free from the bullae with prednisolone, could considerably reduce the dose of prednisolone without reappearance of the lesions. The potentiating effect of *Glycyrrhiza* appeared to be due to its inhibitory effect on the metabolic degradation of prednisolone (Saxena *et al.*, 1965*a*).

A controlled clinical trial was conducted on 92 randomly selected cases of post-operative traumatic inflammation following tonsillectomy with powdered *G. glabra* given in a dose of 3 g. t.d.s. in 28 cases. In another series of 24 cases, oxyphenbutazone 2 tablets t.d.s. were given. On sequential analysis, the anti-inflammatory response of *G. glabra* was found to be equivalent to that of oxyphenbutazone. *G. glabra* appeared to posses a more potent anti-pyretic and anti-exudative activity in comparison to oxyphenbutazone (Saxena *et al.*, 1970).

In a clinical trial conducted on 32 cases of allergic conjunctivitis, glycyrrhetinic acid drops were found to be of definite therapeutic value both in acute and long standing cases. Its value in phlyctenular conjunctivitis, episcleritis and infective conjunctivitis was doubtful (Saxena *et al.*, 1965*b*).

The anti-anaphylactic activities of glycyrrhetic acid, 6-bromoquinazolone, imipramine, desmethylimipramine and amitriptyline were studied against egg albumin aerosol-induced bronchospasm in guineapigs. Glycyrrhetic acid (80 mg./kg.) did not show any significant protection, as compared to other drugs (Gupta *et al.*, 1970).

Glycyrrhetic acid showed an antipyretic activity similar to that of sodium salicylate on rectal temperature of normal and pyretic rats. Imipramine was devoid of such a response. It could only show hypothermic effect in 4 hours, which was not shared by glycyrrhetic acid (Saxena and Bhalla, 1968).

Glycyrrhizin showed a significant antidiuretic effect in rats and rabbits on oral and parenteral administration. Crude *G. labra*, however, did not show any significant effect in human volunteers even in high doses *i.e.* up to 20 g. (Gujral *et al.*, 1961*c*).

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## GMELINA (Verbenaceae)

*G. ARBOREA* Linn.

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Gamari | Mar. | — | Shivanasal |
| Guj. | — | Shewan | Punj. | — | Kumhar |
| Hind. | — | Gambhara | Tam. | — | Gumuaduteku, kaataanam |
| Mal. | — | Kumbula | Tel. | — | Gumartek |

**Habitat :** Found in the lower Himalayas, the Nilgiris and the east and west coast of India.

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**Parts used :** Root, bark, fruit and leaves.

**Ayurvedic description**

Sanskrit : *Kaashmarya*

Synonyms : *Gambhaari, shreeparni, kaashmeeri, kashmeerya, mrudee, heera, madhuparnika, krishnavrinta, bhadraparni, kumbhaari, saphala, mahee*

Properties :
- *Rasa* — *Madhura, tikta, kashaaya*
- *Guna* — *Guru*
- *Veerya* — *Ushna*
- *Vipaaka* — *Katu*

Actions/Uses :
- General : *Deepanee, paachanee, bhedani, bhramahara, shoshahara, trishnaghna, aamadoshahara, shoolaghna, arshoghna, vishaghna, daahaghna, jwaraghna*
- Flowers : *Madhura, kashaaya* and *tikta* in *rasa*; *sheeta* in *veerya*; *madhura* in *vipaaka*; *raktapittaghna, asrikdaraghna*
- Fruits : *Kashaaya, amla* in *rasa*; *snigdha* and *guru* in *guna*; *sheeta* in *veerya*; *madhura* in *vipaaka*; *hridya, rasaayana, brihmana, shukrala, kshayaghna, medhya, mootrakrichraghna, trishnaa prashamana, daahaghna, raktapittahara, kshatakshayaghna.*

**Medicinal properties and uses :** Root is demulcent, stomachic, bitter tonic, refrigerant and laxative. Tender leaves are demulcent. Fruit is sweetish-bitter and cooling. Extract of root is bitter and tonic. Root is an ingredient of the *dasamula* of the vaidyas. It is used in the form of infusion or decoction in fever, indigestion, anasarca *etc.* With liquorice, sugar and honey, it is given as a galactagogue in cases of scanty secretion of milk in women. Leaves ground to paste with water are applied to the forehead in headache and fevers (Nadkarni, 1954).

**Pharmacognosy :** The pharmacognostic investigations of the root bark and stem bark have been carried out.

Macroscopic characters : The mature root-bark when fresh is yellowish in colour. Dry pieces are curved and channelled, thinner ones forming single quills. The external surface is rugged due to the presence of vertical cracks, ridges, fissures and numerous lenticels. Taste is mucilaginous, sweetish with slight bitterness. The fracture is short and granular.

The mature stem bark occurs as flat and slightly curved pieces. The external surface is slightly rough due to the presence of a few cracks, ridges, *etc.* Fracture is short and granular.

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Microscopic characters : In mature root-bark, the cork is represented by 10-18 layers of tangentially elongated rectangular cells. Phelloderm is composed of parenchyma and groups of stone-cells. The secondary phloem consists of parenchyma, groups of stone-cells, sieve tube elements and medullary rays.

In mature stem bark, cork is made up of 12-20 layers of slightly thick walled lignified cells. Phelloderm is parenchymatous and contains stone-cells. The secondary phloem has a similar structure as described above.

Parenchyma cells contain acicular crystals of calcium oxalate. Starch grains, oil globules and resin are present. Root powder mounted in nitrocellulose gave a dirty yellow fluorescence with violet tinge, while stem powder gave dirty yellow fluorescence under UV light (Prasad, 1970).

**Chemistry :** Luteolin has been isolated from the leaves of *G. arborea*. The ether extract on concentration deposited a yellow solid which, on repeated crystallisation, gave yellow crystalline substance, $C_{15}H_{10}O_6$, m.p. 322-25°. The substance gave the characteristic colour reactions of flavones. It formed a tetra-acetate, m.p. 224-26°, $C_{23}H_{18}O_{10}$ and a tetramethyl ether, $C_{19}H_{18}O_6$. This flavone was identical with luteolin (Rao *et al.*, 1967).

Further chemical examination of the leaves led to the isolation of apigenin, quercetin, hentriacontanol and β-sitosterol as crystalline components. The petroleum ether extract on chromatography gave a neutral substance, m.p. 87°, which analysed for $C_{31}H_{64}O$, and was inferred to be hentriacontanol. The benzene extract after further processing gave a sterol, m.p. 136-38° which formed an acetate, m.p. 128-30°, and was confirmed as β-sitosterol. The chloroform extract also gave a small quantity of β-sitosterol. The alcohol extract gave positive tests for flavones. After concentration and repeated crystallisation, a pure crystalline substance, m.p. 322-25°, was obtained, which was identified as luteolin. Paper chromatography of the residue from the mother liquor showed the presence of three flavonoids (A, B and C) which were separated. Flavonoid A had m.p. 348-50°, $C_{15}H_{10}O_5$ and was identified as apigenin. Flavonoid B was found to be identical with luteolin. Flavonoid C had m.p. 318-22°, $C_{15}H_{10}O_7$ and was considered identical with quercetin. A comparison of the yields of the three flavonoids showed that luteolin was the major component, apigenin and quercetin being the minor components (Rao and Rao, 1970).

From the heartwood of *G. arborea*, a new long chain ester clutyl ferulate, m.p. 80-82° has been isolated for the first time in a yield of 0·04 per cent. The ester gave a faint ferric colour. It formed a crystalline monoacetate, $C_{40}H_{68}O_5$, m.p. 96-98°. The structure for the ester has been proved by synthesis from ferulic acid and cluytyl alcohol (Govindachari *et al.*, 1971).

**Pharmacology :** The *rasayana* (anabolic) effect of the fruits of *G. arborea* was studied in rabbits using electrophoretic analysis of serum fractions, body weight and physical

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behaviour as parameters. An increase in the percentage of $\alpha_2$ and $\gamma$-globulin fractions, gain in body weight and alertness in physical behaviour was observed after treatment with the drug (Gaur and Gupta, 1968).

The alcoholic extracts of the stem bark and wood of the stem were found to possess hypoglycaemic activity in albino rats. The stem bark extract also showed anti-viral activity against *Ranikhet disease virus* (Dhar *et al.*, 1968).

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# GOSSYPIUM (Malvaceae)

*G. ARBOREUM* Linn.

| | | | | | |
|---|---|---|---|---|---|
| Eng. | — | Cotton | Mar. | — | Deokapas |
| Hind. | — | Nurma, kapas | Punj. | — | Kapas |
| Kan. | — | Hatti, arale | Tam. | — | Semparutti, |
| Mal. | — | Chemparutti | Tel. | — | Patti |

**Habitat :** Grown all over India.

**Parts used :** Roots and seeds

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**Ayurvedic description**

Sanskrit : *Kaarpaasee*

Synonyms : *Tundikeri, samudraanta, aachchaadanaphala, padma, patada, bandhyaphala, pichu, bhaaradwaaji*

Properties : *Rasa* — *Madhura, kashaaya*
*Guna* — *Laghu*
*Veerya* — *Ushna*
*Vipaaka* — *Madhura*

Actions/Uses : General : *Ruchya, hritbalakara, trishnaahara, daaghaghna, shramaghna, bhraantihara, moorchaghna, vranaghna, shastrakshataapaha*

Leaves : *Raktakrit, mootravardhana, karnapeedaahara, karnapidakaghna, karnanaadaghna, karnapooyahara, karnaasrahara*

Seeds : *stanyadaa, vrishya*

**Medicinal properties and uses :** Roots are used in fever. Seeds are used in gonorrhoea, gleet, chronic cystitis and catarrh (Chopra *et al.*, 1956).

**Chemistry :** Cotton seed hulls contain an appreciable quantity of a leuco-anthocyanidin. It was identified by conversion into the corresponding anthocyanidin which proved to be delphinidin. Therefore, the leuco-anthocyanidin was identified as leucodelphinidin (Chandra and Seshadri, 1957).

Gossypol, a colouring matter, has been found located in specialised pigment glands in the seeds of *G. arboreum*. The root is also a good source. It has been found to be optically inactive whereas gossypol isolated from *Thespesia* species was optically active being strongly dextrorotatory. The pigment molecule is fairly complex and has the composition $C_{30}H_{30}O_8$. It has a binaphthyl skeleton with six hydroxyl groups, two aldehyde groups and a pair of isopropyl and methyl groups. Its structure has been confirmed by synthesis. A gossypol sample is found to be a mixture of several forms, some of which have been isolated as the stable methyl ethers (Seshadri, 1971).

**Pharmacology :** The aqueous extracts of the whole plant, leaves, seeds, root bark and stem bark of G. *arboreum* exhibited uterine stimulant action, the leaf extract being the most potent. The stimulant action was noted on the uteri of albino rat, rabbit, guineapig, dog and cat *in vitro* and *in vivo* as well as on the isolated human myometrium. The extracts behaved more like oxytocin than ergometrine. The effect of the extracts was not blocked by atropine, priscol or cyproheptadine and thus appeared to be a direct action. The stimulant effect, however, could be blocked completely by papaverine hydrochloride in a dose of 0·1 mg./kg. (Kadambari, 1967; Kadambari and Santhakumari, 1969). On the mammary glands of oestrogen-primed albino rats, the hot water extract of the seeds exhibited maximum activity in causing an increased

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lobulo-alveolar growth, ductal proliferation and secretory activity. On non-oestrogen primed rats, the extract produced proliferative changes with some amount of secretory activity in the mammary gland. Uterine weight decreased significantly and there was a reduction in the adrenal weight concurrent with significant increase in the cholesterol and ascorbic acid levels. On post-partum rats, an increase in the milk yield both on the 10th and 14th day associated with an increase in the weight of litters was observed with the extract. There was a retardation of the involutionary changes after litter removal. The extract produced similar changes as those produced by cortisol in the histological pattern of the mammary gland of oestrogen-primed and post-partum rats after litter removal. There was also evidence of ACTH inhibition by the extract which further supported the possibility of its effect being due to a sterol content .Acute toxicity studies showed that the extract was non-toxic even in a dose of 2 g./100 g. body weight in mice (Kasturibai, 1969).

The aqueous extract of the leaves of *G. arboreum* exerted hypotensive action probably due to a cardiac depressant and peripheral vasodilater effect. In addition, it also stimulated the smooth muscles of the intestine by a direct effect and had no action on the skeletal muscle. The extract also exhibited diuretic activity comparable in magnitude to that of potassium chloride, but differing from it in the nature of urine excreted. Large doses of the drug rendered the urine acidic with increased excretion of sodium and chloride (Kadambari, 1967).

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## GREWIA (Tiliaceae)

*G. HIRSUTA* Vahl. (Syn. *G. polygama* Mast., *G. pilosa* Roxb.)

Hind. — Kukurbicha
Mar. — Govli
Tel. — Jibilike

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**Habitat :** Occurs in sub-Himalayan tracts up to 1500 m. from Indus eastwards, Bihar and Orissa.

**Parts used :** Fruit and root.

**Medicinal properties and uses :** Fruit and root are used in diarrhoea and dysentery. Root is pounded in water, applied externally to hasten suppuration and as a dressing for wounds (Chopra *et al.*, 1956).

*G. POPULIFOLIA* Vahl. (Syn. *G. temax* (Forsk.) Fiori)

Punj. — Ganger Tel. — Kaladi

**Habitat :** Much branched shrub; found in Punjab, Sind, Rajputana and Western India, down to the Nilgiri Hills.

**Parts used :** Mucilage of bark

**Medicinal properties and uses :** Mucilage of bark is used by women of west tropical Africa to clean the hair of vermin (Chopra *et al.*, 1956). It has pesticidal properties and the plant is also used in hilly areas of northern India in the treatment of tuberculosis (Sarkar and Khanna, 1959).

**Pharmacognosy :** Pharmacognostic studies of *G. hirsuta* and *G. populifolia* have been carried out.

*G. hirsuta*

Macroscopic characters : The roots are cylindrical, its external surface dark brown with violet tinge and faint longitudinal anastamosing ridges and numerous lenticels. Fracture is hard and fibrous. Odour is indistinct and taste is mucilaginous.

Microscopic characters : The cork is composed of 3-5 layers of suberised cells. The phelloderm is a narrow zone of 12-16 layers. Groups of fibres occur in this region. The crystal fibres are elongated, thick-walled and divided by transverse partitions. The xylem shows a diffused porous arrangement and a distinct growth ring near the centre. It consists of vessels, trancheids, fibre-tracheids, fibres and parenchyma. The ray cells are thick-walled, lignified, having simple pits on their walls. Starch grains, prismatic crystals of calcium oxalate, mucilage and resin are present. The root powder as such or when mounted in nitrocellulose or in 1N-NaOH in methanol exhibits bluish white fluorescence (Prasad, 1970).

*G. populifolia*

Macroscopic characters : The roots occur in pieces of varying length and thickness with brown exterior and yellowish-white interior. The mature bark shows fine longitudinal anastamasing ridges, fissures and occasional transverse lenticels.

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**Microscopic characters :** The primary structure of the root is diarch to tetrarch. The most important diagnostic character of the root-bark is the presence of the phloem fibres arranged in concentric bands, each band being surrounded by crystal fibres and extending from one medullary ray to another. The rays are 1-3 cells in width and 6-13 cells high in the inner region of the phloem. Crystals of calcium oxalate, starch grains, resin, tannin, volatile and fixed oil are present (Prasad and Wahi, 1962).

**Chemistry :** Air dried powdered stem was percolated with light petroleum. Successive eluates gave : a pale yellow oil, b.p. 180-84°; β-sitosterol, m.p. 137-38°; α-amyrin, m.p. 184-86°; $C_{30}H_{50}O$; β-amyrin, m.p. 196°, $C_{30}H_{50}O$, faradiol m.p. 210°, $C_{30}H_{50}O_2$.

Paper chromatography of the residue of aqueous extract showed the presence of proline, serine, glutamic acid, phenylalanine, isoleucine and lysine (Sarkar and Khanna, 1959).

**Pharmacology :** The crude alcoholic extract of *G. populifolia* showed no antitubercular action *in vivo* against *Mycobacterium tuberculosis* $H_{37}R_V$. The alcoholic extract gave a slight increase in intestinal motility (Sarkar and Khanna, 1959).

The alcoholic extracts of the stem-bark of *G. elastica* and aerial parts of *G. latifolia* were found to have CNS depressant activity in mice. The extract of the latter species also possessed antiviral activity against *Ranikhet disease virus* (Bhakuni *et al.*, 1969). The alcoholic extract of the entire plant *G. hirsuta* showed diuretic activity in albino rats. The extract also possessed CNS depressant activity. It responded to strychnine seizure threshold test, amphetamine hyperactivity test and rotarod test in mice. Antiviral activity was also shown by the extract against *Ranikhet disease virus* (Bhakuni *et al.*, 1971).

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# GYMNEMA (Asclepiadaceae)

*G. SYLVESTRE* R. Br. (Syn. *Asclepias geminata* Roxb).

| | | | |
|---|---|---|---|
| Guj. and Mar. — | Kavali | Tam. — | Shirukurunja |
| Hind. and Ben. — | Chhota-duddhilata, gurmar | Tel. — | Bodaparta |

**Habitat :** A climbing plant common in central and southern India, on the western ghats and in Goa.

**Parts used :** Roots and leaves.

**Ayurvedic description**

Sanskrit : *Meshashringee*

Synonyms : *Ajashringee, madhunaashinee, ghanashringee, shringee, shreevriksha, paadavriksha, chakshuhya, bahulaangaka, chakranemee, sarpadamshta, medravalli, varatikta, mahaakaalee, tiktadugdha, dwiteeya, dakshinaavarta, supuchchika*

Properties :
*Rasa* — *Kashaaya, tikta*
*Guna* — *Laghu, rooksha*
*Veerya* — *Ushna*
*Vipaaka* — *Katu*

Actions/Uses : *Daahaprashamana, timiraghna, kaasaghna, shwaasaghna, vranaghna, kriminaashana, kushthaghna, mehaghna*

**Medicinal properties and uses :** The roots are astringent, stomachic, tonic and refrigerant. The leaves cause hypoglycaemia in experimental animals, and stimulate heart and circulatory system, increase urine secretion and activate the uterus (Nadkarni, 1954). The leaves have a peculiar property of neutralising temporarily the taste sensation for sugars and hence the name *gurmar* it is given (Wahi and Chunekar, 1964).

**Pharmacognosy :** The macroscopic and microscopic characters of the leaves of *G. sylvestre* have been described. The lamina is ovate, elliptic or ovate-lanceolate, with both surfaces pubescent. Microscopically it was observed that hairs are non-glandular, profusely present all over the surface. There are five vascular bundles, a fan shaped bundle in the centre flanked on either side by two small bundles. The midrib has a ventral bulge. In the lamina, rosette crystals of calcium oxalate are present in idioblasts in the spongy parenchyma. Palisade ratio, vein-islet number, veinlet-termination number, stomatal number *etc.* have also been worked out (Wahi and Chunekar 1964).

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**Chemistry :** The presence of gymnemic acid, (+) -quercitol, lupeol, β-amyrin, stigmasterol *etc.* have been reported from *G. sylvestre.* Saponins have been found to be present in the alcoholic extract of the plant. Several methods were tried for the isolation of the saponin. By chromatography and hydrolysis, a colourless crystalline product was obtained, m.p. 157° which was an aglucone of the saponin. This saponin produced a stable froth with water and had an astringent taste (Chakravarti *et al.*, 1966).

**Pharmacology :** The effect of the alcoholic extract of the leaves of *G. sylvestre*, *Tribang shila* (an Ayurvedic preparation) and tolbutamide on blood sugar was compared in normal rats as well as those rendered hyperglycaemic by daily administration of the anterior pituitary extract. Both *G. sylvestre* (100 mg./kg.) and *Tribang shila* (40 mg./kg.) administered orally caused insignificant reduction in blood sugar in normal rats but produced marked and significant reduction in anterior pituitary-treated hyperglycaemic animals. The effect of *G. sylvestre* was comparable to that of tolbutamide (50 mg./kg.) in the hyperglycaemic rats. The drug seemed to influence the disturbed carbohydrate metabolism in hyperglycaemic animals probably by limiting the carbohydrate turnover and inhibiting the vicious cycle of hyperglycaemia (Gupta and Seth, 1962).

The alcoholic exttact of the leaves inhibited hyperglycaemia of the 3rd hour (one and half hour after glucose administration) in albino rats rendered hyperglycaemic by anterior pituitary extract. The effect was probably due to its influence on the glucose tolerance in these animals. Inhibition of the hyperglycaemic response of the anterior pituitary extract at 6, 12 and 24 hours was most marked after both tolbutamide and *G. sylvestre* (Gupta, 1963*a*). The alcoholic extract prevented the loss of body weight of rats caused by prolonged administration of anterior pituitary extract (Gupta, 1962).

The effect of parenteral administration of the alcoholic extract of leaves on the hyperglycaemic response of the diabetogenic hormones, somatotropin and corticotropin has been studied in albino rats. The somatotropin-induced hyperglycaemia was markedly inhibited by the extract in a dose of 200 mg./kg. intramuscularly. The inhibition of the corticotropin-induced hyperglycaemia was also observed with the extract (Gupta and Variyar, 1964).

The effect of aqueous infusion of the leaves on glucose tolerance was investigated in albino rats. The percentage increase in blood sugar after one and two hours of glucose meal was found to be significantly less when the animals were pretreated with the infusion as compared to that observed during control tests. Glucose tolerance seemed to be influenced through their indirect pancreotrophic effect due to a sensitization of β-cells of the islets of Langerhans for secreting larger amount of insulin in response to glucose (Gupta, 1963*b*).

The body weight of the rats treated with *G. sylvestre* was found to be increased as compared to controls. The weekly food consumption in terms of g./kg. body weight was found to be less in rats treated with the plant as compared to controls indicating thereby better utilization of food. The urine output was also greater in the rats treated with the drug (Gupta *et al.*, 1965).

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*G. sylvestre* blocked specifically the sweet taste receptors when applied to the tongue of human volunteers. After application of the leaf powder to the tongue the perception of sweet taste of compounds like sucrose, glucose, saccharin sodium, dl-alanine, glycerol and sodium salicylate was abolished in all the subjects whereas the taste of chloroform remained unaffected even in threshold concentration. Two possibilities have been suggested for the negative effect on chloroform sweetness, viz., (*i*) chlorofrom acts on a distinct receptor and (*ii*) chloroform has high intrinsic activity, so that it can displace gymnemic acid from the sweet receptor site easily (Amladi *et al.*, 1970).

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# GYMNOSPORIA (Celasteaceae)

*G. ROTHIANA* Laws

**Habitat :** A common shrub found in deciduous and ever green forests, abundant on the Konkan hills.

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**Chemistry :** From the hexane extract of the stem of *G. rothiana*, four crystalline compounds were isolated by column chromatography. They were β-amyrin, β-sitosterol, 3, 11-diketo-olean-12-ene and a new triterpene of the oleanone group, gymnosporol $C_{30}H_{46}O_3$. Based on the spectral data gymnosporol has been found to be 3, 11-diketo-6-β-hydroxy-olean-12-ene $C_{30}H_{46}O_3$ (Govindachari *et al.*, 1970).

**Pharmacology :** The alcoholic extract of the aerial parts of *G. falconeri* has been found to possess CNS depressant activity in mice. It responded to strychnine seizure threshold test, amphetamine hyperactivity test and rotarod test (Bhakuni *et al.*, 1971).

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## GYNANDROPSIS (Capparidaceae)

*G. PENTAPHYLLA* DC (Syn. *Cleome gynandra* Linn.)

| | | | | | |
|---|---|---|---|---|---|
| Ben. | — | Arkahuli | Mal. | — | Karvala |
| Eng. | — | Caravalla seeds | Mar. | — | Hulhul |
| Hind. | — | Harhur, karaila | Tam. | — | Velaikeerai |
| Kan. | — | Shrikala | Tel. | — | Vavminta |
| Kon. | — | Shirkal | | | |

**Habitat :** Annual plant, cultivated in warmer parts of India. In odour it resembles asafoetida. Its small kidney-shaped black seeds resemble those of *Cleome viscosa*.

**Ayurvedic description**

Sanskrit : *Sooryaavarta*

Synonyms : *Arkakaanta, divyateja, sheetavriksha, ravivalli, varada, moolaparni, sukhodbhawa, suvarchala, sooryabhakta, ravipriya, arkapushpee, prithveeka, paarthee, brahmasuvarchala*

Properties :

| | | |
|---|---|---|
| *Rasa* | — | *Tikta, kashaaya* |
| *Guna* | — | *Guru, rooksha, sara* |
| *Veerya* | — | *Sheeta* |
| *Vipaaka* | — | *Madhura* |

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Actions/Uses : *Vishtambhaghna, vaataraktahara, kaasaghna, aruchighna, jwaraghna, vishphotahara, kushthaghna, mehaghna, paandughna*

**Medicinal properties and uses :** Seeds are antispasmodic, sudorific, anthelmintic and carminative. Bruised leaves are rubefacient and vesicant (Nadkarni, 1954).

**Pharmacognosy :** Macroscopically *G. pentaphylla* resembles *Cleome viscosa*. The detailed pharmacognostic characters of the leaves have been studied (Puri, 1971).

**Chemistry :** Hexacosanol, β-D-glucoside of β-sitosterol, free β-sitosterol and kaempferol have been isolated from the seeds of *G. pentaphylla*.

Hexacosanol was obtained after crystallisation from ethanol and chromatography over alumina as colourless microcrystalline product, m.p. 77-79°, $C_{26}H_{54}O$ and was optically inactive.

β-D-glucoside of β-sitosterol crystallised from excess of ethanol as colourless needles, m.p. 290-92°, $C_{35}H_{60}O_6$. The glucoside on hydrolysis yielded β-sitosterol, m.p. and mixed m.p. 135-37°. The mother liquor left after the separation of hexacosanol and the above glucoside gave free β-sitosterol. From the total alcoholic extract a yellow crystalline product m.p. 273-75° was obtained having molecular formula $C_{15}H_{10}O_6$, and was confirmed as kaempferol (Gupta *et al.*, 1968).

**Pharmacology :** The alcoholic extract of the entire plant *C. pentaphylla* was found to have anti-cancer activity against human epidermal carcinoma of the nasopharynx in tissue culture and hepatoma 129 in mouse (Dhar *et al.*, 1968).

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# Appendices

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## APPENDIX I.

### List of Plants Classified according to Activity

(Pure compounds, whereever screened, are indicated in parentheses)

**Plants with Antifertility activity**

*Abrus precatorius*
*Aloe indica*
*Ananascomosus*
*Areca catechu*
*Artabotrys odoratissimus*
*Azadirachta indica*; **spermicidal** (sodium nimbidinate)
*Butea frondosa*
*Butea monosperma* (butrin, palasitrin)
*Caesalpinia bonducella*
*Canscora decussata*; **spermicidal** (unidentified crystalline fractions I and II)
*Carica papaya*
*Curcuma longa*
*Daucus carota*
*Embelia ribes*
*Ensete superbum* (crystalline fraction VIDR-2GD)
*Ferula alliacea* (byakangelicin)

**Plants with Uterine activity**

*Abroma augusta*; **oxytocic**
*Abrus precatorius*
*Anagallis arvensis*
*Annona squamosa*
*Areca catechu*
*Aristolochia bracteata*
*Asparagus racemosus* (also **galactotropic**)
*Bombax malabarica*
*Carica papaya*
*Costus speciosus* (crystalline saponin)
*Cyperus rotundus*
*Gloriosa superba*
*Gossypium arboreum*



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**Plants with Anti-inflammatory and Anti-arthritic activity**

*Alangium lamarckii* (unidentified alkaloidal compound)
*Allium sativum* (alliin)
*Berberis aristata* (berberine)
*Boerhaavia diffusa*
*Cassia fistula*
*Clerodendron phlomidis*
*Commiphora mukul* (steroid compound)
*Costus speciosus* (saponins mixture)
*Crataeva nurvala* (sterols)
*Crotalaria laburnifolia* (crotalaburnine)
*Curcuma longa* (curcumin)
*Cyperus rotundus*
*Cyperus scariosus*
*Dalbergia lanceolaria* (phytogenic crystalline principle)
*Desmodium gangeticum*
*Diospyros cordifolia*
*Glycyrrhiza glabra* (glycyrrhizin, glycyrrhetic acid, glycyrrhetinic acid)

**Plants with Central nervous system activity**

*Acacia arabica*
*Aconitum sps.*; **writhing** (aconitine)
*Acorus calamus* (asarone)
*Acronychia laurifolia*
*Alnus nepalensis*
*Anogeissus latifolia*
*Apium graveolens* (unidentified alkaloid)
*Areca catechu* (arecoline)
*Artemisia scoparia*
*Atropa sps.* (atropine, scopolamine)
*Bacopa monniera* (hersaponin)
*Barleria cristata*
*Boswellia serrata*
*Cannabis indica* (cannabinol)
*Canscora decussata* (unidentified crystalline fraction)
*Carissa opacea*
*Carum roxburghianum*
*Cassia fistula*
*Cedrella toona*
*Celastrus paniculatum* (unidentified crystalline compound Mal III A)
*Centella asiatica* (brahmosides)
*Cestrum diurnum*

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*Chrysanthemum leucanthemum*
*Cissampelos pariera* (hayatin and its derivatives)
*Convolvulus pluricaulis*
*Curcuma amada*
*Curcuma aromatica*
*Cymbopogon nardus*
*Cyperus retundus*
*Dillenia indica*
*Diospyros cordifolia*
*Elaeocarpus ganitrus*
*Elsholtzia cristata*
*Emblica officinalis* (phyllemblin)
*Erythrina variegata* (crystalline alkaloids)
*Euphorbia tirucalli*
*Euphorbia dranunculoides*
*Fagonia cretica*
*Ficus religiosa* (β-sitosteryl-D-glucoside)
*Glochidion hohenackeri*
*Glycosmis mauritiana*
*Glycosmis pentaphylla* (glycosine)
*Glycyrrhiza glabra* (glycyrrhetic acid)
*Grewia elastica*
*Grewia hirsuta*
*Gymnosporia falconeri*

**Plants with Cardiovascular activity**

*Acacia farnesiana*
*Achyranthes aspera* (crystalline alkaloid, saponins)
*Aconitum sps.*, producing arrhythmia (aconitine)
*Acorus calamus*
*Aegle marmelos*
*Artabotrys odoratissimus*
*Artemisia vulgaris*
*Asclepias curassavica* (asclepine glycoside)
*Azadirachta indica* (nimbidin, sodium nimbidinate)
*Calophyllum inophyllum* (calophyllolide coumarin)
*Calotropis procera*
*Carica papaya* (unidentified crysalline fraction AC-48)
*Carissa carandas*
*Catharanthus roseus*
*Cerbera odollam* (cerberin)
*Cestrum diurnum* (crystalline saponins)
*Cestrum nocturnum* (crystalline saponins)

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*Cissampelos pariera* (hayatin and its derivatives)
*Cissus quadrangularis* (crystalline glucoside)
*Cocculus hirsutus*
*Cocos nucifera*
*Convolvulus pluricaulis*
*Crotalaria juncea*
*Daucus carota*
*Digitalis lanata* (digoxin)
*Elaeocarpus ganitrus*
*Emblica officinalis* (phyllemblin)
*Euphorbia neriifolia*
*Evolvulus alsinoides* (unidentified crystalline alkaloid)
*Fagonia arabica*
*Feronia narthex*

**Plants with Antihypertensive activity**

*Achyranthes aspera* (crystalline alkaloid, saponin)
*Ailanthus excelsa*
*Alangium lamarckii* (unidentified alkaloid)
*Anchusa strigosa*
*Aristolochia bracteata* (crystalline water soluble alkaloid)
*Artemisia sps.* (scoparone)
*Arundo donax*
*Bacopa monniera*; **biphasic**
*Bergenia ciliata*
*Butea superba*
*Canscora decussata* (unidentified crystalline fractions I and II).
*Cardiospermum helicacabum*
*Carissa carandas*
*Carum copticum*
*Cassia absus* (chaksine-alkaloid)
*Catharanthus roseus* (unidentified alkaloid fraction V-22)
*Cocculus hirsutus*
*Convolvulus pluricaulis*
*Crotalaria agatiflora*
*Crotalaria brevifolia* (usarmine)
*Crotalaria sericea* (monocrotaline)
*Croton sparsiflorus* (crotsparine; N-methyl dihydrocrotsparine, apo-N-methylcrotsparine)
*Curcuma longa* (curcumin)
*Cynodon dactylon* (unidentified alkaloid and glycoside)
*Daucus carota*
*Dendrobium macraei* (unidentified crystalline compound)
*Dioscorea prazeri* (crystalline saponins)

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*Emblica officinalis*
*Ensete superbum* (erystalline fraction VIDR-2 GD)
*Ficus bengalensis*
*Ficus racemosa*
*Fumaria parviflora*
*Gossypium arboreum*

**Plants with Hypoglycaemic (anti-diabetic) activity**

*Achyranthes aspera*
*Aegle marmelos*
*Alangium salvifolium*
*Allium cepa*
*Alnus nepalensis*
*Anacardium occidentale*
*Atropa belladona*
*Bambusa dendrocalamus* (unidentified crystalline compound)
*Barleria prenoites*
*Barleria cristata*
*Berberis aristata* (berberine)
*Cassia auriculata*
*Cassia fistula*
*Cedrella toona*
*Clerodendron infortunatum*
*Coccinia indica* (unidentified quarternary base)
*Cryptostegia grandiflora*
*Datura quercifolia*
*Diospyros preragrina*
*Elaecarpus ganitrus*
*Ensete superbum*
*Erythrina suberosa*
*Eugenia jambolana*
*Euphorbia hirta*
*Ficus bengalensis* (unidentified glycoside)
*Ficus glomerata*
*Ficus religiosa* (β-sitosteryl-D-glucoside)
*Glochidion hohenackeri*
*Gmelina arborea*
*Gymnema sylvestre*

**Plants with Anti-cancer activity**

*Abrus precatorius*
*Albizzia lebbeck*

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*Alstonia scholaris*
*Amura rohitaka*
*Anacardium occidentale*
*Annona squamosa*
*Aphanamixis polystachya*
*Argemone mexicana*; **carcinogenic**
*Asparagus racemosus*
*Bacopa monniera*
*Bergenia ciliata*
*Boswellia serrata*
*Calotropis procera*
*Calotropis gigantea*
*Cedrus deodara*
*Cocculus pendulus*
*Corchorus aestuans*
*Datura metel*
*Erythrina suberosa*
*Euphorbia hirta*
*Gynandropsis pentaphylla*

**Plants with Hypolipaemic and Anti-atherosclerotic activity**

*Agave vera-cruz*
*Cicer arietinum*
*Commiphora mukul* (unidentified crystalline compound)
*Curcuma amada*
*Curcuma longa* (sodium curcuminate)

**Plants with Anti-bacterial activity**

*Acorus calamus*; **anti-tubercular**
*Achyranthes aspera*; **anti-lepra**
*Alpinia galanga* **anti-tubercular**
*Amura rohitaka*
*Anagallis arvensis*
*Andrachne aspera* (unidentified alkaloid)
*Areca catechu*
*Argemone mexicana*
*Arnebia nobilis* (crystalline alkannin derivatives)
*Asteracantha longifolia*
*Azadirachta indica* (nimbidin and sodium nimbidinate)
*Berberis aristata*; **anti-cholera** (berberine)
*Bryophyllum calycinum*
*Capparis decidua*

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*Carissa carandas* (carissone-3-(O-carboxyphenyl) hydrozone; 3, 3′ -bis-(carissyl) thio-carbohydrazone and carissone-3-N′-homopiperidyl-hydrazone)
*Cassia fistula* (unidentified crystalline flavonoid glycoside CFRI)
*Cassia occidentalis*
*Cocos nucifera* (polysaccharide compound of coconut water)
*Crotalaria juncea*
*Cucurbita maxima*; **anti-tubercular**
*Cucurbita pepo*; **anti-tubercular** (peposin)
*Curcuma longa*
*Cyperus rotundus*
*Desmodium gangeticum*
*Emblica officinalis*
*Eruca sativa*
*Ervatamia coronaria*
*Eucalyptus citroidora*; **anti-tubercular** (citriodorol)
*Euphorbia prostrata*
*Garcinia talboti*
*Grewia populifolia*; **anti-tubercular**

**Plants with Anti-fungal activity**

*Asteracantha longifolia*
*Cassia fistula*
*Cocos nucifera*
*Desmodium gangeticum*
*Euphorbia thymifolia*

**Plants with Anti-viral activity**

*Amura rohitaka*
*Atalantia racemosa*
*Azadirachta indica* (nimbidin and sodium nimbidinate)
*Caesalpinia bonducella*
*Caesalpinia sepiaria*
*Canscora decussata*
*Capparis decidua*
*Cassia auriculata*
*Cassia tora*
*Celastrus paniculatum*
*Cocculus pendulus*
*Cynodon dactylon*
*Cyperus nivens*
*Diospyros preragrina*

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*Eclipta alba*
*Emblica officinalis*
*Ensete superbum* (crystalline fractions VIDR-2T,VIDR-2GC, VIDR-2GD)
*Gmelina arborea*
*Grewia hirsuta*
*Grewia litifolia*

**Plants with Anti-protozoal activity**

*Acacia arabica*
*Alangium salvifolium*
*Albizzia lebbeck*
*Asparagus racemosus*
*Atropa belladonna*
*Berberis aristata* (berberine)
*Calendula officinalis*
*Cedrella toona*
*Centella asiatica*
*Cinchona sps.* (emetine, conessine, quinine, quinidine, chloro-dihydro and hexa-hydro derivatives of desoxy guinine and guinidine)
*Cissus setosa*
*Clerodendron infortunatum*
*Coccinia indica*
*Curcuma longa*
*Diospyros preragrina*
*Euphorbia hirta*
*Euphorbia tirucalli*
*Ficus racemosa*
*Ficus religiosa*

**Plants with Anthelmintic activity**

*Aegle marmelos* (marmelosin)
*Alangium lamarckii*
*Amura rohitaka*
*Anagallis arvensis* (acetyl saponin)
*Artemisia meritima* (santonin)
*Butea frondosa* (palasonin)
*Capparis decidua*
*Carica papaya* (benzylthiourea)
*Clerodendron infortunatum*
*Cucurbita maxima*
*Dalbergia latifolia*

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*Datura metel*
*Datura quercifolia*
*Embelia ribes*
*Ficus religiosa*

**Plants with Insecticidal activity**

*Acorus calamus*
*Annona squamosa*
*Euphorbia neriifolia*

**Plants with Diuretic and Anti-urolithiatic activity**

*Achyranthes aspera* (saponins)
*Anagallis arvensis*
*Azadirachta indica* (sodium nimbidinate)
*Barleria prinoites*
*Bergenia ciliata*
*Boerhhavia diffusa*
*Caccinia glauca* (caccinin and caccinetin—glycoside and aglucone)
*Cassia occidentalis*
*Crataeva nurvala*
*Cucumis melo*
*Dalbergia volubilis*
*Dolichos biflorus*
*Glycyrrhiza glabra*; **anti-diuretic** (glycyrrhizin)
*Grewia hirsuta*

**Plants with Anti-asthmatic and Anti-histaminic activity**

*Allium sativum*
*Citrullus colocynthis* (coloside-A-glycoside)
*Clerodendron serratum* (saponin)
*Curcuma longa*

**Plant with Respiratory activity**

*Alpinia galanga*

**Plant with Anti-peptic ulcer activity**

*Brassica oleracia*

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**Plants with Astringent activity**

*Caesalpinia bonducella*
*Capparis decidua*; **purgative**
*Carum coptis*
*Cassia fistula;* **purgative**

**Plants with Anti-coagulant activity**

*Calotropis procera*
*Carica papaya* (unidentified crystalline principle AC-48)

**Plants with Haematinic activity**

*Cleistanthus collinus* (cleistanthin—glycoside)

**Plants with Wound-healing properties**

*Aloe vera*
*Cissus quadrangularis*
*Garcinia morella* (morellin)

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## APPENDIX II.

### Glossary of Sanskrit/Ayurvedic terms

| | |
|---|---|
| *Aachchaadanaphala* | an encased fruit |
| *Aadhmaanakaree* | that which causes flatulence |
| *Aadhmaanaghna, aadhmaanahara* | anti-flatulant |
| *Aagoodha* | uncovered, exposed |
| *Aakhuvishaghna* | an antidote for rat-poisoning |
| *Aakhuparnika* | leaves resemble the ear of a rat |
| *Aamadosha* | broadly refers to food intoxication usually associated with faulty digestion (and impaired metabolism) |
| *Aamadoshaghni, aamadoshahara* | counteracts the effects of *aamadosha* |
| *Aamadoshakara* | that which causes/promotes impairment of the gastro-intestinal digestion |
| *Aamaateesaaraghna* | anti-diarrhoeic |
| *Aamragandhiharidraa* | turmeric with the flavour of mango (Mango ginger) |
| *Aanaahaghna* | that which relieves constipation |
| *Aartawajanana* | one which promotes ovulation/menstrual flow |
| *Aasyavairasyanaashana* | anti-anorectic |
| *Aayushya* | beneficial to life |
| *Aayushkara* | promoter of life |
| *Abha* | lustrous |
| *Adahshalya* | amplexicaul |
| *Aadhmaanashamana* | palliative of abdominal distension |
| *Adoosha* | that which does not cause a homeostatic disequilibrium of the *tridoshas* |
| *Agnideepti, agnikaaraka, aghnivardhaka, agnyuttejaka* | that which stimulates the factors of gastro-intestinal digestion |
| *Agnimaandyahara* | antidyspeptic |
| *Agnimaandyaprashamana* | palliative of dyspeptic states |
| *Agnijit* | palliative of hyperactivity of the digestive enzymes |
| *Agnidagdhashamanee* | that which relieves the effect of burns |
| *Agnishikhaa* | resembling the flame both in shape and colour |
| *Aguru* | light (not heavy) |
| *Aindree* | liked by God Indra |
| *Ajagandha* | having the smell of a goat |



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| | |
|---|---|
| *Ajamoda* | that which is very much liked by goats |
| *Ajashringee* | that which looks like the horns of a goat |
| *Ajeernaghna* | that which corrects indigestion |
| *Akshihita* | beneficial to the eye |
| *Akshirogaghna* | indicated in eye-diseases |
| *Alaabu* | that which is suspended |
| *Ambhashta* | that which grows in the rainy season |
| *Amshumati* | having long, radiating roots |
| *Amogha* | efficacious |
| *Amrita, amruta* | like nectar/ambrosia |
| *Amritaphala* | fruits with nectar (ambrosia)-like properties |
| *Amritodbhava* | originating from nectar/ambrosia |
| *Analadeepani* | same as *agnideepti* |
| *Ananta* | countless/innumerable/abundant |
| *Angaaravalli* | a creeper with bright red flowers |
| *Angamardaprashamana* | anodyne/analgesic |
| *Anilahara* | alliviator of *vaata* |
| *Ankolasadrishi* | that which resembles *Ankola* (*Alangium lamarckii*) |
| *Anooshna* | not hot |
| *Anulomana* | sending or putting in the right direction (purging) |
| *Anulomani* | that which regulates the bowel movements |
| *Anupashaya* | harmful, that which aggravates ailments |
| *Anupushpaka* | with small (rudimentary) flowers |
| *Apacheeghna* | that which resolves glandular enlargement |
| *Apakwa* | unripe, immature |
| *Apasmaaraghna* | anti-epileptic |
| *Apatra* | without leaves |
| *Apsara* | aquatic |
| *Arevataa* | that which promotes excretion of body wastes |
| *Arshahita,* | beneficial in haemorrhoids |
| *Arshaghna, Arshoghna* | anti-haemorrhoidal |
| *Aruchighna, aruchihara, aruchishamana* | anti-anorectic |
| *Asaaraah* | sapless |
| *Ashmaghna, ashmareeghna, ashmaantaka, ashmareebhedana* | indicated in urolithiasis |
| *Asrasrutinaashana* | anti-haemorrhagic |
| *Asthisanhaara, asthishrinkhala* | that which promotes healing of bone fractures |
| *Ateesarashamani* | anti-diarrhoeal |
| *Atilekhana* | exessive reduction of body weight |
| *Atistambha* | haemostatic |

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| | |
|---|---|
| *Aayugmapatra* | a plant with odd number of leaves |
| *Aayurvriddhikara* | that which promotes longevity |
| *Baalapatra* | tender leaf |
| *Badakandinee* | with firm/strong rhizomes |
| *Baddhamootraghna* | that which relieves anurea |
| *Bahleeka* | originating from Balk |
| *Bahudruma* | many-branched |
| *Bahupatra* | many-leaved |
| *Bahupushpa* | many-flowered |
| *Bahusutaa* | with multiple shoots |
| *Bala* | refers to the tenacity and capacity to survive under adverse environmental factors |
| *Balabuddhivivardhini* | promotor of muscular strength, resistance to disease, and intellect |
| *Balakara* | promoter of physical strength and resistance |
| *Balamedhonalavardhini* | promoter of strength, intellect and digestive power |
| *Balaprada* | that which gives strength and resistance to disease |
| *Balya* | this term carries two meanings *viz.* muscular strength, tone as could be judged from one's capacity to perform physical work; and resistance to disease, decay and degeneration. Resistance to disease has two aspects *viz.* combating the virulence of the disease and capacity to inhibit or neutralize the cause of the disease |
| *Beejapoora* | full of seeds |
| *Bhagandaraghna* | useful in the treatment of fistula-in-ano |
| *Bhagnasandhaanakara* | that which promotes fracture healing |
| *Bhavya* | pleasant/beautiful |
| *Bhedana* | purgation |
| *Bhedaneeya* | that which causes drastic purgation |
| *Bhootaghna, bhootaapaha* | with psycho-active, and/or anti-microbial action |
| *Bhraantihara* | that which cures delusion |
| *Bhramahara* | that which promotes clarity of mind and dispels confusion |
| *Bhramakara* | that which produces giddiness, mental confusion |
| *Bhrimhana* | that which promotes the body bulk |
| *Bhringaara* | that which blackens the hair |
| *Bodha* | awakening/arousing |
| *Brihatkushtaghna* | antileprotic |
| *Buddhiprada* | that which promotes intellectual faculties |

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| | |
|---|---|
| *Chakshushya* | beneficial to the eyes |
| *Chakshusraavahara* | that which relieves ocular discharges |
| *Chala* | mobile |
| *Chandanagandha* | that which smells like the sandal wood |
| *Chardi* | vomiting |
| *Chardighna, chardishamani* | anti-emetic |
| *Charmakantaka* | a skin disease |
| *Charmaranga* | that which stains |
| *Chaturthikavishamajwaranaashini* | anti-malarial (particularly against quartan fever) |
| *Chatushpatree* | four-leaved |
| *Chedanee, chedini* | expectorant |
| *Chetavikaarinee* | that which produces mental disorders |
| *Chinchaapatri* | tamarind leaves |
| *Chirapaakee* | that which takes a long time to ripen or to get digested |
| *Daahahara, daahashamanee* | refrigerant, relieves burning sensation |
| *Daakshinaatya* | native of south India |
| *Dadhikashaayaamladala* | leaf with the smell of curd and tasting astringent and sour |
| *Dadrughna* | indicated in scaly affections of the skin |
| *Dadrupaamaahara* | indicated in scaly and exudative affections of the skin |
| *Dakshinaavarta* | facing to the right |
| *Dala* | petals |
| *Dantachchada* | covered with tooth-like spikes |
| *Dantarogaghna* | effective in dental diseases |
| *Dantya* | that which promotes the health of teeth |
| *Deepana* | same as *agnideepana* |
| *Deepanapaachana* | gastric stimulant and digestant |
| *Deepyaka* | that which improves digestion |
| *Deergha* | long, lengthy |
| *Deerghakandika* | long rhizomes |
| *Deerghapaadapa* | a tree having long roots |
| *Deerghakeela* | with long spikes |
| *Deerghamooli* | long-rooted |
| *Deerghaphala* | elongated fruits |
| *Deerghapatra* | long-leaved |
| *Deerghapushpa* | long flowers |
| *Deerghavalli* | long creeper |
| *Devadhooma* | incense of the angels |
| *Dhaatupushtikara* | that which nourishes the body tissues |
| *Dhaatupushtivardhaka* | nutrient tissue homologues which nourish the tissue |

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| | |
|---|---|
| *Dhamana* | throbbing |
| *Dhawala* | white |
| *Dhoopavriksha* | a tree, parts of which are used as incense |
| *Dhoorta* | thorn-apple |
| *Dhruva* | confers stability |
| *Dooramoola* | having long roots |
| *Dridhabeeja* | sturdy seeds |
| *Dridhavriksha* | sturdy tree |
| *Dridhapatra* | having sturdy leaves |
| *Dridhaphala* | fruit with a hard kernel |
| *Drikprasaadakara* | capable of promoting vision |
| *Dugdhaanika* | with milky latex |
| *Dugdhagarbha* | a stem rich in milky latex |
| *Duhpradarsha* | haemorrhoids producing burning sensation |
| *Duhsparsha* | unpelasant to touch |
| *Dushtavranashodhana* | healer of indolent, sloughy ulcers |
| *Dwajaabhamadhyaadanda* | stem resembles a flag-staff |
| *Edagaja* | small in stature or size |
| *Gaandhaaree* | which occurs in *Gaandhaaradesha* (the present Afghanistan) |
| *Gajabhakshya* | food of elephants |
| *Galagandahara* | indicated in glandular swellings of the ventral part of the neck (goitre?) |
| *Gandamaalahara, gandaari* | indicated in glandular swellings in the neck region |
| *Gandhamoolika* | aromatic roots |
| *Gandhapatra* | aromatic leaves |
| *Gandhapushpa* | aromatic flowers |
| *Garala* | poison |
| *Garavishahara* | that which is said to neutralise noxious or poisonous potions |
| *Garbhaantaka, garbhapaatakara* | abortifacient |
| *Garbhaashayasamshodhani* | said to cleanse the uterus |
| *Garbhapatana* | that which induces abortion |
| *Garbhasraavahara* | anti-abortifacient |
| *Garbhasthaapana* | that which promotes conception (pregnancy) |
| *Gavaadanee* | serves as cattle fodder |
| *Gavaakshee* | resembling the cow's eye |
| *Ghantaarava* | fruits produce a metallic sound on shaking |
| *Gobhee, gojee, gojihwa* | leaves of which are rough like the cow's tongue |
| *Graahi* | that which binds the bowel (astringent) |
| *Grahaghna* | useful in psychiatric involvement |
| *Grahanirogahara, grahanirogaghna* | indicated in malabsorption syndrome/chronic amoebiasis/colitis |

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| | |
|---|---|
| *Granthila* | knotted, knotty, nodular |
| *Granthirogaghna* | indicated in glandular swelling |
| *Grantighna* | that which cures glandular enlargement |
| *Graahiphala* | a fruit with astringent property |
| *Guchchapushpa* | cluster of flowers |
| *Gudaartihara* | that which relieves rectal pain |
| *Gudabhramshahara* | indicated in prolapse of the rectum |
| *Gudakeelakahara* | indicated in haemorrhoids, rectal polyp |
| *Gudapushpa* | a sweet flower |
| *Gudarogaghna* | useful in proctological disorders |
| *Gulmaghna, gulmahara* | indicated in the treatment of tumour-like conditions of the abdomen |
| *Guptasneha* | refers to the volatile oil present in the plant material |
| *Guru* | heavy, that which is digested slowly |
| *Haridruma* | golden yellow latex |
| *Hidmanaashaka, hikkaghna hikkaashamana* | indicated in hiccough |
| *Hridrogaghna, hridrogahara* | indicated in heart diseases |
| *Hridya* | cardiac tonic |
| *Hridayaavasaadaka* | cardiac depressant |
| *Hridrogashamana* | indicated as a palliative in heart diseases |
| *Jalodaranaashanee* | useful in the treatment of ascites |
| *Jantughna, jantunaashanee* | anthelmintic, antimicrobial ? |
| *Jantuphala* | fruits infested with small insects |
| *Jantuvishaghna* | indicated in animal (insect) bites |
| *Jarana* | digestion |
| *Jeernajwarahara* | useful in the treatment of chronic fevers |
| *Jwaraghna, jwarahara, jwaravegav, naashaka* | antipyretic |
| *Kaakatundi* | resemblance of the fruit to a crow's beak |
| *Kaalindee* | blackish plant |
| *Kaamalaghna, kaamalaahara* | that which cures jaundice |
| *Kaamini* | that which is liked or desired |
| *Kaanchanee* | gold colour |
| *Kairaataka* | grows in places inhabited by the *Kiraata* tribe |
| *Kairala* | grown in abundance in Kerala |
| *Kalihaaree* | that which eliminates the vitiated *doshas* |
| *Kamja* | aquatic |
| *Kandoohara, kandooghna* | indicated in skin conditions associated with itching |
| *Kantakee* | thorny |
| *Kantakeekaranja* | thorny stem |
| *Kantakiphala* | thorny fruit |

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| | |
|---|---|
| *Kantharogavinaashani, kantharogahara* | that which cures throat disorders |
| *Kanthashodhana* | that which cleanses the throat |
| *Kanthashoolashodhana* | that which relieves throat pain |
| *Kaantaashobhinee* | that which makes women look beautiful |
| *Kaasaghna, kaasahara* | anti-tussive |
| *Kaasapeenasahara* | indicated in chronic bronchitis and rhinitis |
| *Kaashmareephala* | fruit native to Kashmir |
| *Kaashmeeraja, kashmeera* | that which occurs in Kashmir |
| *Kanthasoukumaaryakara* | that which is soothing to the throat (voice ?) |
| *Kapaalavisarpaghna* | indicated in erysipelas of the scalp |
| *Kapeetana* | tree with widespread branches |
| *Kapipriya* | that which is liked by monkeys |
| *Kaphaateesaaraghna* | that which cures diarrhoea produced by *kapha* |
| *Kaphajwarahara, kaphajwaraghna* | that which cures fever caused by *kapha* |
| *Kaphakaasahara* | that which cures cough originating from *kapha* |
| *Kaphapittashamana* | that which relieves the *kapha-pitta dosha* |
| *Kaphapittajwaraghna* | which cures fever involving *kapha* and *pitta* |
| *Kaphonmaadaghna* | cures insanity produced by *kapha* |
| *Kaphashophahara* | cures oedema produced by *kapha* |
| *Kaphodarahara* | cures abdominal disease produced by *kapha* |
| *Karavee* | that which resembles a peacock |
| *Karnaartihara, karnashoolaghna* | that which relieves pain in the ear |
| *Karnaasrahara* | indicated in bleeding from the ear |
| *Karnanaadaghna* | which relieves tinnitus |
| *Karnapeedaahara* | that which relieves ear ache |
| *Karnapidakaghna* | that which is indicated in the treatment of furuncles in the ear |
| *Karnapooyaharam* | indicated in otorrhoea |
| *Karnarukshamani* | that which relieves ear ache |
| *Karnavranahara* | indicated in ear ulcers |
| *Karnavyaadhivinaashana* | indicated in the treatment of ear diseases |
| *Karnikara* | stem with many buds |
| *Karshana* | which promotes slimming of the body |
| *Kashaaya* | astringent |
| *Katabhee* | that which bears resemblance to the face of an elephant |
| *Katu* | pungent or bitter in taste |
| *Katukeephala* | bitter fruits |
| *Kaushika* | that which exudes from the trunk bark |
| *Kavacha* | a covering |
| *Keela* | warty growth |
| *Keetamaaraka* | anthelmintic, insecticidal |
| *Keshaphala* | a hairy fruit |

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| | |
|---|---|
| *Keshya* | that which promotes the growth of hair |
| *Kharaashwa* | that which is eaten by donkeys |
| *Kharapatra* | leaves with a rough surface |
| *Kinihee* | indicated in the healing of ulcers |
| *Kinshuka* | flowers resemble the beak of a parrot |
| *Kiraatatikta* | intensely bitter |
| *Kokilaaksha* | fruits resemble cuckoo's eyes |
| *Kolam* | having sour taste |
| *Koorchashekhara* | having a brush-like appearance |
| *Krimihara, krimighna* | vermicidal/anthelmintic/anti-microbial |
| *Krimidoshahara, krimidoshanaashanee* | indicated in toxic conditions arising on account of insects, worms or microbes |
| *Krimighna* | Anthelmintic, anti-microbial, disinfectant |
| *Krishnapaakaphala* | fruits turning black when ripe |
| *Krishnabeeja* | black seeds |
| *Krishnaphala* | black fruits |
| *Krishnasaara* | black heartwood |
| *Krishnashaalee* | a variety of paddy |
| *Krishnavallaree* | a black creeper |
| *Krshnavrinta* | black stems |
| *Kshaaraja* | composed of alkalies |
| *Kshataghna* | indicated in trauma |
| *Kshatakshayashamanee* | indicated in a wasting disease associated with injury |
| *Kshaarashreshta* | the best among alkalies |
| *Ksheeradruhee, ksheerapaadapa, ksheeree, ksheerika* | a tree with milky latex exuding from all parts |
| *Ksheeraparna* | leaves with milky latex |
| *Ksheeraphena* | frothy, milky latex |
| *Ksheerinee* | fruit with milky latex |
| *Kshudrapatra* | having thin and small leaves |
| *Kshudraphala* | small fruits |
| *Kshutshamani* | that which alleviates hunger |
| *Kuchchatunna* | having a brushy tuft |
| *Kukshishoolahara* | indicated in abdominal colic |
| *Kumbha* | refers to the exudation of a gum resin from pitcher-shaped sacs in the bark |
| *Kushaalmalee* | a tree similar to *shaalmalee* (*Bombax malabarica*), but smaller in stature |
| *Kushalee* | that which promotes "health" (well-being) |
| *Kushtaghna* | indicated in skin diseases |
| *Kutajavatpatra* | leaves resemble those of *kutaja i.e. Holarrhena antidysenterica* |
| *Laghu* | light, easy to digest |

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| | |
|---|---|
| *Laghuparna* | having small leaves |
| *Lataa* | a slender creeper |
| *Lekhana* | act of scraping; reduction of body weight |
| *Lekhani* | that which aids in reducing corpulency |
| *Lochinee* | soothing to the eye |
| *Lohita* | red or crimson colour |
| *Lootahara* | indicated in spider-bite |
| *Maamsakara* | that which promotes muscle growth |
| *Maarkava* | indicated in the treatment of greying of hairs |
| *Maashalochana* | having eyes like black gram |
| *Madagandhi* | an intoxicating aroma |
| *Madakara, madani* | intoxicant |
| *Madana* | that which intoxicates or exhilarates |
| *Madhudruma* | refers to sweetness of all parts of the tree |
| *Madhukarkati* | sweet melon |
| *Madhumehaghna* | antidiabetic (hypoglycaemic) |
| *Madhuparnika* | a honey-like juice obtained from the leaves |
| *Madhurakaashta, madhuyashti* | sweet stems (refers to *Glycyrrhiza glabra*) |
| *Madhuramoolika* | sweet root |
| *Madhusraava* | a tree with sweet exudate |
| *Mahaakanda* | a large rhizome |
| *Mahaakleetaanika* | indicated in the treatment of impotence |
| *Mahaakushtaghna* | anti-leprotic |
| *Mahaamohee* | that which produces delusion/confusion |
| *Mahaaphala* | large fruit |
| *Mahaushadha* | a drug having a wide range of action |
| *Mahishaaka* | colour resembles eyes of a buffalo |
| *Malamootrasamshodhaka* | that which aids in the elimination of body wastes including faeces and urine |
| *Malapaatana* | aids in the elimination of body wastes including the faeces |
| *Mardaka* | which produces pain when rubbed |
| *Marudbhava, marusambhava* | native to arid zones |
| *Matsyaakshi* | leaves are like the eyes of the fish |
| *Mayooraka* | flowers are coloured like the peacock |
| *Medhya, medhakara, medhyakara* | that which promotes memory and intellect |
| *Medohara, medoghna* | causes reduction of obesity |
| *Mehaghna* | that which relieves polyurea |
| *Mohanaashinee* | indicated in the treatment of delusion |
| *Mootrakrichra* | dysurea |
| *Mootrakrichrahara* | indicated in dysurea |
| *Moodhagarbha* | difficult and delayed labour |
| *Moodhagarbhahara* | indicated in difficult and delayed labour |

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|---|---|
| *Moorchaahara, moorechaghna* | indicated in the treatment of spells of fainting |
| *Mootradoshahara* | that which cleanses urinary disorders |
| *Mootrala* | diuretic |
| *Mootrashodhani* | that which cleanses the urine |
| *Mootravardhana* | that which promotes micturition and diuresis |
| *Mootravirechanee* | that which promotes increased micturition |
| *Mriduphala* | soft fruit |
| *Mridurechaka* | laxative (mild purgative) |
| *Mukharoganaashani* | indicated in the treatment of the diseases of the oral cavity |
| *Mukharookshaghna, mukhashoshahara* | that which relives dryness of the mouth |
| *Mukharukhara* | that which relieves pain in the oral cavity |
| *Mukhashodhanee* | that which cleanses the mouth |
| *Naagadanti* | resembles an elephant's tusk |
| *Naanaagrahanaashani* | indicated in the treatment of various psychiatric disorders |
| *Naarangavarnaka* | orange colour |
| *Neela* | blue/black |
| *Neelaphala* | blue/black fruit |
| *Neelapushpa* | blue/black flowers |
| *Nepaala* | that which grows abundantly in Nepal |
| *Netrarogahara, netrarogaghna* | indicated in the treatment of eye diseases |
| *Netrarukshamani* | palliative in the treatment of painful eye diseases |
| *Netravikaarashamanee* | palliative in eye disorders |
| *Netravranahara* | indicated in ulcerative conditions of the eye |
| *Netrya* | beneficial to the eyes |
| *Nidraanaashanee* | that which causes insomnia |
| *Nigoodhapatra* | concealed leaves |
| *Nishkantaka* | a plant devoid of thorns |
| *Paachana, paachani* | digestive |
| *Paandughna, paanduhara* | anti-anaemic |
| *Paanimardaka* | that which can be crushed by the palm or that which bruises the palm |
| *Paaraseekayavaani* | refers to the original habitat of *vavam* |
| *Paaraavatapadi* | leaves resemble pigeon's feet |
| *Paaribhadra* | that which protects the body |
| *Paashaanabheda* | that which breaks stones |
| *Pachampacha* | that which promotes digestion |
| *Padmaata* | resembles lotus |
| *Palankasha* | which reduces the body-bulk (particularly the body fat) |
| *Panktikanda* | refers to the linear arrangement of rhizomes and leaves |

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|---|---|
| *Panktipatra* | refers to the linear arrangement of the leaves |
| *Paramavrishya* | that which promotes optimum virility |
| *Parjanya* | that which protects health |
| *Peetakaalika* | yellow bud |
| *Peetaphala* | yellow fruit |
| *Peetapushpa* | yellow flower |
| *Peeluparnika* | that which has tiny leaves |
| *Peeluphala* | tiny fruit |
| *Peenasaghna, peenasanaashini* | indicated in the treatment of chronic rhinitis |
| *Phalasugandhika* | fragrant fruits |
| *Pichchasambhruta* | refers to viscosity and pastiness of the sap |
| *Pichchila* | sticky, gummy |
| *Pichumarda* | a cure for skin diseases |
| *Pindeetaka* | globular fruits |
| *Pipaasashamani* | that which relieves polydypsia |
| *Pittajwaraghna* | indicated in the treatment of fever due to *pitta* |
| *Pittashamana* | anti-bilious |
| *Pittaateesaaraghna* | indicated in diarrhoea due to *pitta* (enteritis ?) |
| *Pleeharogaghna, pleehodarahara* | indicated in splenomegaly |
| *Pradaraghna* | anti-leucorrhic |
| *Pradeepa* | that which blazes |
| *Prakeerna* | spreading out in all directions |
| *Pramehaghna, pramehashamana* | relieves polyurea (diabetes) |
| *Prasekashamana* | palliative of excessive salivation |
| *Prasthapushpa* | large flowers |
| *Prataanika* | ramifications |
| *Prativisha* | an anti-dote for poisons |
| *Pratyakpushpa* | flowers pointing downwards |
| *Pravaahikaghna* | anti-dysenteric |
| *Preenanam* | that which is soothing |
| *Prithupatra* | wide/broad leaves |
| *Priyaka* | that which is pleasant |
| *Punarnavaa* | self-renewing, rejuvenating |
| *Pushpasaurabha* | floral fragrance |
| *Pushpee* | having flowers |
| *Pushtikara* | promotes nutrition of the body |
| *Rajodoshaprashamanee* | palliative in menstrual disorders |
| *Raktaamayaghna, raktavikaaraghna* | treatment of haematological disorders |
| *Raktaateesaarashamana* | palliative in haemorrhagic dysentery |
| *Raktadoshaghna* | indicated in blood dyscrasias |
| *Raktakanda* | red rhizome |
| *Raktakrit* | haematinic |

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|---|---|
| *Raktakusuma, raktapushpa* | red flower |
| *Raktaphala* | red fruit |
| *Raktapittaghna* | indicated in the therapy of haemorrhagic diathesis |
| *Raktapittashamana* | palliative in haemorrhagic diathesis |
| *Raktapittastambhana* | haemostatic |
| *Raktarenu* | red powder |
| *Raktashodhaka* | that which purifies the blood |
| *Raktastambhani* | that which promotes clotting |
| *Raktavardhaka* | haematinic |
| *Raktavikaarashamani* | indicated in haematological disorders |
| *Raktika* | red coloured |
| *Raktotklishta* | blood disintegration (haemolysis ?) |
| *Rasaayana, rasaayanee* | rejuvenator |
| *Rasaayani* | lymphatics |
| *Rechana* | purgation |
| *Rechani* | purgative |
| *Rochaka* | that which promotes the taste and appetite |
| *Rochana* | stomachic |
| *Rohinee* | that which promotes wound healing |
| *Rooksha* | rough |
| *Ruchiprada, ruchidaa* | that which stimulates appetite |
| *Ruchya* | appetiser |
| *Rujaapaha* | analgesic |
| *Saamya* | that which promotes steady state equilibrium (of the *doshas*) |
| *Sadaapushpi* | flowering throughout the year |
| *Sadaaphala* | fruiting throughout the year |
| *Sahasravedhi* | a plant with numerous actions |
| *Sangraahi* | that which binds the bowels (usually an astringent) |
| *Sannipaatajwarahara* | indicated in highly toxic fevers (c.f. pneumonia, typhoid, meningitis, *etc.*) |
| *Saptachakraka* | transection of the root reveals seven concentric rings |
| *Saptachchada* | leaves with seven segments |
| *Sarpadamshtra* | resembling the fangs of a serpent, snake bite |
| *Sarpamooshikavishahara* | antidote for poisoning by snake and rat bites |
| *Sarpadashtavishaghna* | antidote for poisoning by snake bites |
| *Sarvakandoovinaashini* | indicated in pruritus of multiple etiology |
| *Satiktaka* | bitter in taste |
| *Shadgrantha* | having six knots |
| *Shakritshodhana* | that which eliminates faeces |
| *Shamidwara* | used for sacrificial purposes |

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|---|---|
| *Sharkaraanivaarana* | hypoglycaemic |
| *Sharkaraashmareenaashaka* | indicated in the treatment of urinary gravel |
| *Shastrakshataapaha* | indicated in the treatment of traumatic injuries |
| *Shataahwa* | many flowered |
| *Shatapatrika* | a flower with many petals |
| *Shatapatri* | with many leaves or petals |
| *Shataveerya* | a plant with numerous activities |
| *Sheetanut* | that which lowers the body temperature and produces chills |
| *Shikhaa* | with a tuft |
| *Shilaavalkala* | hard bark |
| *Shirovirechna* | that which promotes evacuation of the cranial sinuses |
| *Shirorogaghna* | indicated in the treatment of cranial diseases |
| *Shishnashoolaghna* | said to cure shooting pain of the phallus |
| *Shishubheshaja* | that which promotes child health |
| *Shlakshnatwak* | a plant with a smooth and soft bark |
| *Shleepadaghna* | that which is said to cure elephantiasis |
| *Shodhana* | radical elimination/purification |
| *Shodhaneeya* | that which cleanses and eliminates |
| *Shoolaghna, shoolanaashanee, shoolaapaha* | said to cure colic (generally abdominal) |
| *Shoshaghna* | anti-cachectic |
| *Shothaghna, shophaghna* | anti-oedematous/anti-dropsy |
| *Shramaghna, shramahara* | that which relieves fatigue |
| *Shristavinmootrakara* | that which increases the quantity of stools and urine |
| *Shukapriya* | liked by parrots |
| *Shuklaprada, shukrapravardhaka* | spermatogenetic |
| *Shukrakshayepoositam* | esteemed in the treatment of oligospermia |
| *Shukrakrit, shukrala* | spermatogenetic |
| *Shukti* | dark coloured |
| *Shwaasahita* | useful in the treatment of dyspnoea |
| *Shwaasaghna, shwaasahara* | antispasmodic, antidyspnoic |
| *Shwaaskaasahara* | anti-dyspnoic and anti-tussive |
| *Shwaasashamana* | that which relieves dyspnoea |
| *Shwetakushtaghna* | indicated in the treatment of leucoderma (vitiligo) |
| *Shwetarekhaankitachchada* | leaves with white striations |
| *Shwitraghna, shwitrahara* | indicated in the treatment of vitiligo or leucoderma |
| *Shyaamala* | dark coloured |
| *Sidhmahara* | anti-leprotic (?) |

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|---|---|
| *Sitetara* | a variety of paddy |
| *Skandaphala* | fruit growing in the axil of a leaf |
| *Smritiprada, smritivardhakara* | that which promotes memory |
| *Snaayurogaghna* | indicated in the treatment of diseases of the ligaments, tendons etc. |
| *Snehana* | oleation |
| *Snigdha* | unctous |
| *Somarogaghna* | indicated in the treatment of *Somaroga* (variously interpreted as gynaecological, hormonal, or metabolic disease) |
| *Sookshma* | small, subtle |
| *Sookshmapatra* | tiny leaves |
| *Sookshmapushpa* | small flowers |
| *Sooryabhakta, sooryaavarta* | a flower which always turns towards the Sun (the term *sooryaavarta* also refers to a variety of migraine) |
| *Stanyadaa, stanayavardhani* | that which promotes the secretion of breas milk |
| *Stanyajanaka, stanyakari* | galactogogue |
| *Stanyanaashini* | that which inhibits the secretion of breast milk |
| *Stambhana* | to bind, to retain |
| *Sthooni, sthoonaka* | that which supports |
| *Streepushpajananee* | emmenogogue |
| *Subhadraa* | that which promotes health |
| *Suchakshu* | that which beautifies the eyes or is beneficial to the eyes |
| *Sugandhi* | fragrant smell |
| *Suprasiddha* | very well-known |
| *Surabhi* | a fragrant flower |
| *Surabhipatra* | fragrant leaves |
| *Suradruma* | native to the alpine region of the Himalayas *i.e.* the abode of Gods |
| *Susthira* | that which is extremely stable |
| *Suvarchala* | with beautiful colour |
| *Suvarnaka* | flowers of golden hue |
| *Swaadubeejaka* | sweet seeds |
| *Swaadumoola* | sweet rhizomes/roots |
| *Swaaduphala* | sweet fruit |
| *Swalpakantakee* | having few thorns |
| *Swarya, swaraprada* | that which benefits the voice |
| *Swedahara* | that which inhibits perspiration |
| *Swedakari, swedajanana* | diaphoretic |
| *Swedopaga, swedya* | that which promotes diaphoresis |

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|---|---|
| *Taamra beeja* | coper coloured seeds |
| *Taamramoolee* | copper coloured rhizomes |
| *Taila* | oil |
| *Tammraphala* | copper coloured fruit |
| *Tanuphala* | slender and delicate fruit |
| *Tanutwak* | slender and delicate bark |
| *Tarpana* | satisfying |
| *Tarupungava* | the best among the trees |
| *Teekshna* | acute/pungent |
| *Teevraangamardaghna* | that which relieves acute body ache |
| *Tikta* | bitter |
| *Tiktabeeja* | bitter seed |
| *Tiktadugdha* | bitter latex |
| *Tiktaka* | having bitter taste |
| *Tiktaphala* | bitter fruit |
| *Timirahara, timiraghn* | that which is said to cure cataract |
| *Toolinee* | which yields cotton (fibres) |
| *Tooni* | colicky pain occurring in the iliac or pelvic region of the abdomen |
| *Toyagarbha* | a fruit containing fluid (coconut) |
| *Trishnaahara, trishnaghna, trishnaapaha* | that which relieves thirst |
| *Triparnee* | leaves occurring in threes or a leaf with three segments |
| *Tundikeree* | fruits resemble a parrot's beak |
| *Twagrogaghna* | said to cure various skin disorders |
| *Twak* | bark, skin |
| *Uchchairika* | a tall tree |
| *Udaavartaghna* | said to relieve retention of urine, faeces and flatus |
| *Udaraghna, udararogaghna* | said to cure abdominal diseases |
| *Udarashoolahara* | indicated in abdominal colic |
| *Unmaadahara* | that which is said to cure insanity |
| *Unmatta* | that which induces psychotropic effects (*i.e*, stimulates the central nervous system) |
| *Utkleshashamana* | that which relieves nausea or retching |
| *Vaajeekara* | aphrodisiac |
| *Vaaridaa* | that which resembles the clouds or yields water |
| *Vaarini* | aquatic/aqueous |
| *Vaatabalaasakaghna* | indicated in the treatment of *Vaatabalaasaka*, an oedematous condition associated with fever) |
| *Vaataghna* | indicated in diseases of the nervous system |
| *Vaataghni, vaatapotha* | *anti-vaatic* |
| *Vaataraktaghna* | useful in the treatment of gout-like conditions |

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|---|---|
| *Vaatarogashamani* | palliative in certain forms of diseases of the nervous system |
| *Vaatavedanaahara* | anti-neuralgic |
| *Valaasahara* | that which relieves oedema |
| *Vallee* | creeper |
| *Vamanahara* | that which relieves vomiting |
| *Vamanakara* | that which induces vomiting |
| *Vamanashamani* | anti-emetic |
| *Vamanopaga* | emetic |
| *Vanhiakara* | that which promotes gastrointestinal digestion |
| *Vanhishikha* | resembling the tongues of the fire |
| *Varadaa* | that which promotes health |
| *Varatikta* | the best among the bitters |
| *Varavarnini* | that which improves the complexion |
| *Varnakara, varnya* | useful in promoting complexion of the skin |
| *Varshaabhu* | that which occurs in the rainy season |
| *Vastiphala* | fruits resembling the urinary bladder in shape |
| *Vastirogaghni* | said to cure diseases of the urinary system (particularly of the bladder) |
| *Vastirogahara, vastirogavinaashini* | indicated in the treatment of diseases of the urinary system, specially relating to the bladder |
| *Vastishodhanee* | that which cleanses the urinary bladder |
| *Vastraranjini* | that which can dye the cloth |
| *Vatsaadanee* | that which is liked by children and cattle |
| *Vayasthaapana* | that which promotes longevity |
| *Vedanaasthaapana* | analgesic, local anaesthetic (?) |
| *Veeryaprada* | highly potent |
| *Vibandhashamanee* | that which relieves constipation |
| *Vicharita* | that which is mobile |
| *Vidaahi* | that which causes a burning sensation |
| *Vidradhighna* | that which is said to cure abscesses |
| *Vikaashi* | that which spreads rapidly |
| *Vikeerna* | that which radiates |
| *Virechanee* | purgative |
| *Virekashreshtha* | the best among purgatives |
| *Visarpahara* | that which is said to cure erysipelas |
| *Visha* | poison |
| *Vishaalatwak* | thick (wide) bark |
| *Vishada* | that which is clear, transparent |
| *Vishadoshaghna* | that which is said to cure the disorders caused by poisons |
| *Vishahara, vishaghna* | anti-dote for poisons |
| *Vishalya* | that which removes foreign bodies |

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|---|---|
| *Vishamachchada* | refers to the odd numbers of the segments of the leaves |
| *Vishamajwaraghna* | said to cure remittent and intermittent fevers (like malaria) |
| *Vishanaashana, vishaapaha* | anti-dote for poisons |
| *Vishodhini* | that which purifies or cleanses |
| *Vishramsana* | laxative |
| *Vishtambhi* | that which causes flatulence |
| *Vishtambhakaghnee* | anti-flatulent |
| *Visphotahara* | indicated in eruptive conditions |
| *Vranaapaha, vranaghna* | indicated in the treatment of wounds |
| *Vranapaachana* | that which promotes "ripening" of abscesses |
| *Vranaropana* | that which promotes healing of ulcers and wounds |
| *Vranashodhana* | that which cleanses the wounds |
| *Vriddhinaashani* | indicated in the treatment of growth (benign or malignant) |
| *Vrishabhaakshe* | fruits resembling a bull's eye |
| *Vrishya* | that which promotes virility |
| *Vrishyaphala* | fruits promoting virility |
| *Vrittaguchcha* | round clusters |
| *Vrittapatra* | circular leaves |
| *Vrittaphala* | a globular fruit |
| *Vyaadhighaata* | that which eliminates diseases |
| *Vyaghreedala* | flowers resembling the tail of a tiger |
| *Vyavaayi* | that which is rapidly absorbed and distributed in the body |
| *Yakriduttejaka* | hepatic stimulant |
| *Yakritodaraghna* | that which is said to cure ascitis involving liver pathology |
| *Yakritrogahara* | indicated in hepatic disorders |
| *Yakritvriddhihara* | that which is said to cure hepatomegaly |
| *Yamalapatraka* | compound leaves |
| *Yaugika* | compound |
| *Yavaani* | that which occurs in *Yavana desha i.e.* in such western countries as Greece, Balk, Italy, *etc.* |
| *Yavaasa* | a tree with overlapping and intermingling branches |
| *Yavaneshta* | liked by *Yavanas* (the term *Yavana* includes Greeks, Romans, Jews, *etc.*) |
| *Yavatikta* | fruits resembling barley, bitter in taste |
| *Yonidoshaghna* | that which is said to cure uterine disorders |
| *Yonivishodhana* | that which cleanses the uterus |
| *Yonivyaapadvinaashani* | useful in the treatment of gynaecological disorders |

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| | |
|---|---|
| *Yooka-likshaashamanee* | indicated in the treatment of pediculosis |
| *Yoshinee* | stated to be useful in the promotion of health in women |
| *Yugmapatraka* | leaves are divided into two parts by a furrow at the end, which gives the appearance of two leaves conjoined |

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## APPENDIX III.

### Note on the basic concepts of Ayurveda—The Tridoshas and the Pharmacodynamic aspects

The *Tridoshas**, viz. *Vaata*, *pitta* and *kapha* :

*Vaata* is that primal constituent of the living body, whose structure is *Akaasha-Vaayu*, and whose function is *raajasic*, it being concerned with the production of those physical and mental processes which are predominantly *raajasic* (activating or dynamic) in nautre; hence, the presence of *vaata* is to be inferred in such mental phenomena as exhibition of enthusiasm, concentration, *etc.*, as also in such physical phenomena as respiration, circulation, voluntary action of every kind, excretion and so on. It will be seen that many of these physical phenomena are included among those which modern physiologists would assign primarily to the activities of the nervous system (both cerebrospinal and autonomic).

*Pitta* is that primal constituent of the living body, whose structure is *tejas* and whose function is *saatwic*, it being concerned with the production of those physical and mental processes which are predominantly *saatwic* (balancing or transformative) in nature; hence the presence of *pitta* is to be inferred is such mental phenomena like intellection and clear concentration, as also in such physical phenomena as digestion, assimilation, heat production and so on; it will be seen that many of these physical phenomena are among those which modern physiologists would include under the activities of thermogenetic and nutritional systems (including thermogenesis and the activities of glandular or secretory structures) especially of the endocrine glands whose internal secretions or hormones are now known to be of such vital importance in digestion, assimilation, tissue-building and metabolism generally.

*Kapha* is that primal constituent of the living body, whose structure is *ap-prithvi* and whose function is *taamasic*, it being concerned with the production of those physical and mental processes which are predominantly *taamasic* (conserving or stabilising) in nature; hence the presence of *kapha* is to be inferred in such mental phenomena as exhibition of courage, forbearance, *etc.*, as also in such physical phenomena as the promotion of bodily strength and build, integration of the structural elements of the body into stable structures, the maintenance of smooth working of joints, and so on. It will be seen that many of these physical phenomena are among those which modern physiologists would include under the activities of the skeletal and anabolic systems.

*Extracted from the Report of the Committee on Indigenous Systems of Medicine (1948), Ministry of Health, Government of India, Volume II, Appendix B, p. 347.



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**Pharmacodynamic aspects :**

The term *rasa* refers among other things to taste, chyle (*annarasa*), circulating fluid (the *rasadhaatu*), mercury, etc. In the context of the pharmacodynamical doctrine of Ayurveda, it refers to the taste of a substance as sensed by the tongue. However, it has particular reference to the molecular structure of organic substances which determine, among other things, their tastes. The sweetness of a substance, for example, is determined for the most part by the preponderance in the molecule (the *anu*) of atoms (*paramaanus*) belonging to the *bhautic* species *prithvi* and *ap*. This principle applies with equal force to other tastes *viz*., acid/sour, saline, astringent, acrid and bitter also. Technically, therefore, the term *rasa* refers to the structural composition of molecules and not to tastes as such.

The term *guna* refers to physical qualities of substances as determined by the preponderance of the one or the other of the five species of *bhautic* elements in the structural composition of molecules (*anus*). The classical Indian medicine has described eight primary and twenty secondary qualities.

The term *veerya* refers to energy modalities. The *Charakasamhita* has defined this term thus : "*Veerya* is the power by which an action is performed. No action is possible without *veerya*. All actions are due to *veerya*"[1]. This definition has been accepted by all the ancient authorities. *Veerya* is of two kinds viz. *sheeta* (potential?) and *ushna* (kinetic?). Some ancient authorities have treated the eight primary qualities referred to in *guna*, as *veeryas*. Later in the 13th century A.D., Hemadri described *veerya* as *shakti* or power/energy which, in his opinion, was well known in the world[2].

Literally rendered into English, the term '*vipaaka*' means special transformation/reactions. In the context of its usage in Ayurvedic pharmacology, it refers to biochemical changes foods and drugs undergo during the gastro-intestinal digestion, in the first instance, and towards the conclusion of metabolism in the second. The latter is stated to complete the action ascribed to foods and drugs.[3]

The term '*prabhaava*' describes the specific and characteristic actions of drugs which cannot be explained from the points of view of '*rasa*', '*guna*', '*veerya*' and '*vipaaka*'. In this concept, drugs that possess identical *rasa, guna, veerya* and *vipaaka*—which are referable to their molecular structure, energy modalities, and changes they undergo during the gastrointestinal digestion and metabolism, can perform different and contrary actions. A close examination of this concept shows that it compares with isomers and isomeric action.

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1 "Veeryam tu kriyate yenayaakriyaa. Naa veeryam kurute kinchit sarvaakritaakriyaa" (Charaka Sootra 26, 35)

2 "Lokepiprasiddah" (Hemaadri, Ayurveda Rasaayna commentary on Ast. hrd., Sootra 1, 14).

3 "Vipaaka karmanisthayaa" (Charaka, Sootra 26, 66) and "Karmanishtaa kriyaaparisamaapti" Chakrapaani Datta on the above.

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